

(12) TIME TABLE AND SYLLABUS OF MARINE ENGINEERING DEPARTMENT

Time table for the course and also the detail syllabus are attached herewith.

In addition we are now arranging with Maritime Academy (ALAM) and also the sponsors to conduct Modular Courses for the final year students.

Modular Courses

1. Basic personal survival at sea.
2. Basic fire-fighting at sea.
3. Basic First-Aid at sea.

These will be conducted at the Maritime Academy of Malaysia in Malacca.

The duration of the courses is 2 weeks. The total cost is about \$700/- per student (inclusive of lodging and meal) and these are expected to be borne by the sponsors.

The courses are necessary requirement for holders of 4th. Engineer Certificate upwards. Students of Ungku Omar Polytechnic are eligible to sit for 4th Engineer Certificate of Competency (oral examination only) after having 6 months of sea experience as Junior Engineer upon graduation.

Commencement of course is sometimes in January 1986 are for the MM/82 batch which are currently undergoing sea training.

Pensyarah/Kelas DPl (FIRST YEAR)

TUGAS SAMPINGAN

POLITEKNIK UNGU OMAR, IPOH

JADUAL WAKTU MINGGUAN

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Tarikh: -----

Bahagian: Awam/Elektrik/Jentera/Perkapalan  
TUGAS MENGAJAR

No.	Matapelajaran	Kelas	T Jam P
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	8.00-8.45	8.45-9.30	9.30-10.15	10.15-10.30	10.30-11.15	11.15-12.00	12.00-12.45	12.45-2.00	2.00-2.45	2.45-3.30	3.30-4.15
ISNIN	Workshop Practice				Machine Drawing				Mathematics		Islamic Studies
SELASA	Heat Technology		Mathematic (T)		Electrical Technology	Naval Architecture					
RABU	Engineering Science		Heat & Fluid Technology (T)		Workshop Technology	English					
KHAMIS		Workshop Practice			English	Workshop Technology				Engineering Science	
JUMAAT	Geometrical Drawing		Islamic Studies		Mathematics				2.30-3.15	3.15-4.15	
									← Marine Engineering Practice		

Pensyarah/Kelas DPL (SECOND YEAR)

POLITEKNIK UNGKU OMAR, IPOH

Bahagian: Awam/Elektrik/Jentera/Perkapalan

TUGAS SAMPINGAN

JADUAL WAKTU MINGGUAN

TUGAS MENGAJAR

No.	Matapelajaran	Kelas	T Jam P
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Tarikh: - - - - -

	8.00-8.45	8.45-9.30	9.30-10.15	10.30-11.15	11.15-12.00	12.00-12.45	12.45-2.00	2.00-2.45	2.45-3.30	3.30-4.15
ISNIN	Marine Workshop Technology	Control	Control	Steam Engineering (Turbine)	Steam Engineering (Turbine)	Control (T)		Mechanics of Machines		Internal Combustion Engineering (T)
SELASA										
RABU	Internal Combustion Engineering	Auxiliary Eng. (T)		Marine Workshop Technology (T)	Steam Engineering (Boiler)			Strengths of Materials		Naval Architecture (T)
KHAMIS	Electrical Technology	Islamic Civilization Studies	Islamic Civilization Studies	Naval Architecture	Naval Architecture			Strength of Materials (Laboratory/Tutorial)		
JUMAAT	Islamic Civilization Studies	Control	Mechanic of Machines	Auxiliary Engineering	Auxiliary Engineering			Electrical Technology		

Pensyarah/Kelas DP4 (FINAL YEAR)  
TUGAS SAMPIINGAN

POLITEKNIK UNGKU OMAR, IPOH  
JADUAL WAKTU MINGGUAN

Bahagian: Awam/Elektrik/Jentera/Perkapalan  
TUGAS MENGAJAR

No.	Matapelajaran	KELAS	T Jam P
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Tarikh: -----

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	8.00-8.45	8.45-9.30	9.30-10.15	10.15-10.30	10.30-11.15	11.15-12.00	12.00-12.45	12.45-2.00	2.00-2.45	2.45-3.30	3.30-4.15
ISNIN	Auxiliary Engineering (T)	Marine Electrical Technology	Internal Combustion Engineering (T)		Marine Control System Technology		Pure Mathematics		Materials Technology		Pure Mathematics (T)
SELASA	Marine Engineering Practice		Control (T)		Pure Mathematics	Naval Architecture			Steam Engineering		Stem Engineering (T)
RABU	Applied Electronic		Legislation		Drafting				Mechanical Technology		Auxiliary Engineering
KHAMIS			WORKSHOP						P R A C T I C E		
JUMAT	Internal Combustion Engineering		Auxiliary Engineering (T)		Marine Electrical Technology	Mechanical Technology (T)			2.30-3.15 Design	3.15-4.15	



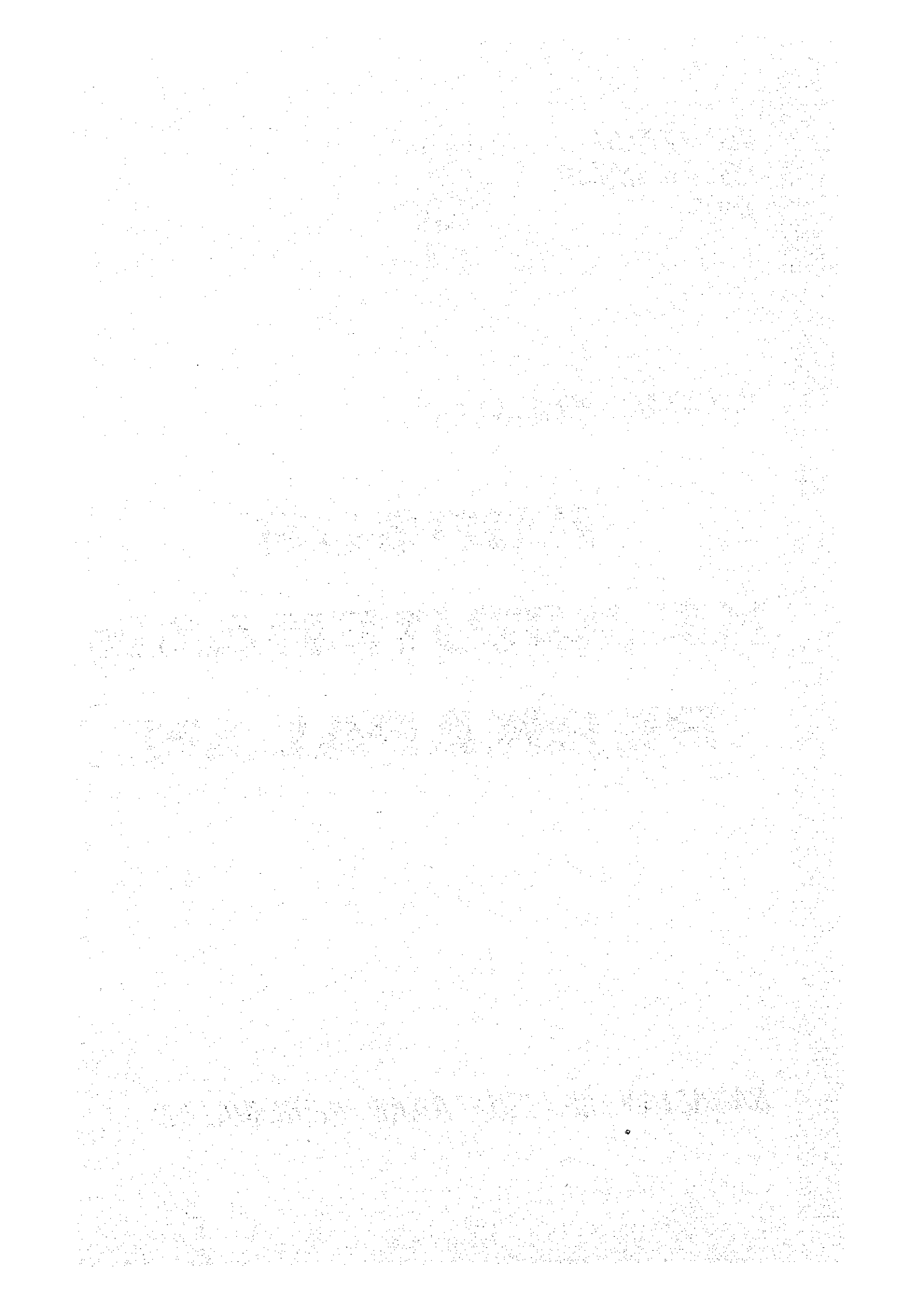
**POLITEKNIK  
UNGKU OMAR,  
IPOH.**



**SUKATAN PELAJARAN**

**KURSUS  
KEJURUTERAAN  
PERKAPALAN**

**BAHAGIAN KEJURUTERAAN PERKAPALAN**



FIRST YEAR



UNGKU OMAR POLYTECHNIC

MARINE ENGINEERING COURSE

FIRST YEAR

- 6.101 Bahasa Malaysia
- 6.102 English
- 6.103 Ugama
- 3.101 Mathematics
- 3.102 Engineering Drawing
- 3.103 Engineering Science
- 3.104 Workshop Technology
- 3.105 Electrical Technology
- 3.106 Heat & Fluid Technology
- 3.111 Marine Engineering Practice
- 3.112 Naval Architecture

SECOND YEAR

- 3.204 Mechanics of Machines
- 3.201 Strength of Materials
- 3.228 Internal Combustion Engineering
- 3.222 Steam Engineering
- 3.223 Auxiliary Engineering
- 3.225 Marine Workshop Technology
- 3.224 Control Systems Technology
- 3.226 Naval Architecture
- 3.227 Electrical Technology

FINAL YEAR

- 3.501 Mechanical Technology
- 3.502 Internal Combustion Engineering
- 3.503 Pure Mathematics
- 3.504 Drafting & Design
- 3.505 Steam Engineering
- 3.506 Naval Architecture
- 3.507 Marine Engineering Practice and Legislation
- 3.508 Control Engineering
- 3.509 Applied Electronics & Electrotechnology
- 3.510 Materials Technology
- 3.511 Auxiliary Machinery

FIRST YEAR

3.101 MATHEMATICS

1. Revision of algebraic formula solutions, logs, use of tables. Extension of logs to negative and fractional exponents including Napierian logarithms. Use of the slide rule, desk calculating machines, multiplication, Division, Powers, roots, Trigonometric functions.
2. Workshop applications of averages, ratios, percentage proportions. Graphical solutions of equations and interpretation (Linear). Determination of laws from data; linear form and those reducible to linear form: use of log-linear equations by successive elimination (with current sum checks). GP sum to infinity; elementary discussion of convergence. The  $(\frac{n}{k})$  notation; (motion of permutation and combinations). Use of Binomial expansion for any real index. Use in approximation of the series for the exponential, logarithmic, sine and cosine functions. Workshop applications. Speeds and feeding in turning and drilling. Workshop applications. Speeds and feeds in milling, Revision.
3. Geometry of the circle, radian measure. Basic Trigonometry. Workshop applications. Simple layout. Sine bar and reference rollers.
4. Tapers, angle measurement, thread measurement. Trigonometric ratios of angles of any magnitude; periodicity and graphs of the circular functions. Addition, product, and double-angle formulae. Notation of inverse circular functions; principal values. Superposition of sine waves. Reduction of  $A \cos C + B \sin C$  to the form  $R \cos (C - C)$  etc. Pythagoras theorem and trigonometrical identities. Sine and cosine rules with workshop applications. Double angle formulae workshop application to large bores. Rectangular and polar co-ordinate systems, algebraic equation of a straight line. Simple curve sketching, characteristics of plane curves, e.g. symmetry, behaviour as X, Y becomes large. Idea of limiting values; functionality; differentiation of algebraic, circular, exponential and logarithmic functions, of product, quotients, functions of a function and simple implicit functions. Gradients; rates of change, maxima and minima. Idea of partial differentiation (1st order only) 2nd and higher order ordinary differentiation.
5. Areas, volumes, weights, common planes and solids. Centres of area, centres of gravity, Pappus Theorem. Second moment of area.
6. Arithmetical progression and geometrical progression. Workshop application to spindle speeds. Approximation of gear ratios, continued fractions. Gear ratios applied to thread cutting, indexing, spiral milling.
7. Binomial theorem and approximation of small errors. Limits with application to graphs. Derivatives, rates of change, slope. Derivatives of formula from tables.

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8. Differential calculus (continued) Maxima and minima - industrial applications. Mid-ordinate rule for finding irregular areas. Theorem of Guldinus (Pappus). Integration as a summation and as the reverse of differentiation. Easy integration of standard forms by substitution and by parts. Integration - integral curves, graphical integration. Definite integration between limits. Integration of trigonometrical functions (Tan  $\theta$ , Cos  $\theta$ , Sine  $\theta$ ). Applications of integration, areas, mean values. Volumes of revolution by integration. Centroids, centre of mass. Moment of Inertia of a circular cylinder about its axis. Simple harmonic motion. Formation of simple differential equations; solution by direct integration; boundary conditions.
9. Handling of data - approximation and accuracy graphs, frequency distributions, histograms. Probability - Simple; addition and multiplication laws. Repeated sampling - Binomial distribution. Poisson's approximation to Binomial distribution, normal distribution, Measures of average and dispersion interpretation.
10. Arithmetic mean and standard deviation, Elementary ideas of probability - Normal distribution - probabilities from normal curve. Normal distribution - approximation to Binomial.
11. Introduction to quality control charts. Control charts for ranges examples. Control charts for means - use of  $\bar{X} \pm A_n \bar{W}$  Quality control charts for fraction defective.
12. Introduction to sampling - characteristic curves. Single, double, and sequential sampling schemes. Introduction to significance test. Students 't' test - use, confidence limits. Students 't' test - examples, interpretation. Variance ratio test - confidence limits for  $X^2$  test - examples and interpretation.

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FIRST YEAR

3.102 ENGINEERING DRAWING

1. Introduction to the importance of Engineering Drawing, use of drawing instruments, introduction to the use of standard lines, introduction to Drawing Office standards including S.I.M., I. S.O. and B.S. 308.
2. Drawing of title blocks, printing and dimensioning, plain and diagonal scales reading to 1/100th, 1/64th, 1/32nd and 1/16th inches.
3. Construction of triangles, quadrilaterals and polygons, construction of tangents and arcs, drawing of gaskets and machine components involving arcs and tangency, introduction to simple orthographic projection and sketching.
4. Orthographic projections of lines and plane figures, sketching of machine parts, areas of plane figures, sketching of workshop tools, orthographic projections of solid in first angle.
5. Ratio of area of plane figures, orthographic projection of machine part, drawing office practice, retailing pivot block, more difficult problems on areas of plane figures, orthographic projection of machine parts, drawing office practice, detailing angle bracket.
6. Construction of conic section - ellipse and parabola. Introduction of third angle orthographic projections.
7. Construction of cycloids, epi-cycloids and hypo-cycloids, construction of hyperbola and involute, orthographic projections and solids in third angle projection, construction of locus of mechanisms, construction of bolts and nuts, simple assembly of swivel bracket and bearing mounting.
8. Sectioning, sections of solids, principles of sectioning, hidden detail, sketching of simple machine tools and components, introduction to isometric drawing of solids, drawing office practice, bearing and bearing housing, use of datum surfaces for dimensioning.
9. Sketching, introduction to oblique drawing, further assembly drawing with sectional views, sketching, first auxiliary views of solid, true shapes of sections, sketching, second auxiliary views of solids, drawing office practice, Detail and assembly of stuffing box.
10. Intersection of solids, cylinder and cylinder, cylinder and cones, exercise on machine drawings, further intersection of solids, sphere and cones forge rod and castings, further exercise on machine drawing.
11. Introduction to development. Pattern of right and oblique cylinders and cones. Further work on development including triangulation method. More exercises on development.
12. Gears - nomenclature of gears. Types of gears. Machine drawing exercise. Construction of spur gears. General revision.

FIRST YEAR

3.103 ENGINEERING SCIENCE

1. Engineering units, symbols, unit ratio for concerting units I.S.O. matters, elements, compound, alloys, mixtures, compositions of air, oxidation, corrosion and combustion.
2. Heat, temperature scales, temperature measurement, kinds of thermometers and recorders. Gas laws and their combination. Continuous flow calorimetry. Fuel calorimetry. Change of state, specific heat, sensible heat. Saturated and unsaturated vapours. Mechanical equivalent of heat. Dalton's law of partial pressures. Elementary treatment of kinetic theory of gases, idea of mean free path. Simple vacuum apparatus. e.g. the rotary pump, the diffusion pump and McLeo gauge. Explanation of hygrometry, industrial hygrometer. Adiabatic and isothermal changes. Use of  $PV^2 = K$ . Conduction and conductors. Commercial heat-insulating materials. Radiation and radiators. Stefan's law. Qualitative account of energy distribution in the spectrum of a full radiator. Element of quantum theory. Heat transfer by conduction, convection and radiation.
3. Optical reflection and refraction and their engineering applications e.g. reflection at plane and spherical surfaces, optical lever and applications, rotation of mirror, formation of images by spherical mirrors. Refractive index of solids and liquids. Refraction through prisms. Deviation, dispersion. Formation of images by single convex and concave lenses. Chromatic aberration. Achromatic combinations. The electro magnetic spectrum. Production of visible spectrum. Simple emission and absorption spectra. Colour, additive and subtractive. Filters. Principles of photography. The camera and photographic plate. Filters for photography. Exposure, developing and fixing. Optical interference. Division of wave front, Young's slits. Division of amplitude - Newton's rings. Qualitative account of the diffraction grating and its use in the control of machine tools. Qualitative account of polarization of light. Uses of polarised light in stress analysis, etc.
4. Sound - Simple harmonic motion, transverse and longitudinal motion. Pitch, loudness and quality. Velocity of sound. Reflection and refraction of sound, application to echosounding and crack detection. Beats. Progressive and stationary waves. Vibration of beams and plates. Simple treatment of force vibration and resonance. Intensity and loudness of sound. The decibel and phon. Simple acoustics of buildings, reverberatic. Principles of methods of recording and reproducing sound..
5. Polygon of forces, vectors and scalars, parallelogram of forces. Graphic solutions to equilibrium problems, moments, couples and torques. Workshop applications.
6. Simple reactions. Simple framework, Node diagram.
7. Direct stresses and strains. Hooke's law, Yield point. Introduction to shear stresses.

## FIRST YEAR

### 3.104 WORKSHOP TECHNOLOGY

#### Welding

1. Oxy-acetylene gas welding, chemistry of reaction and heat output, construction details of cylinder, torches and regulators. Various types of flames available, oxy-gas cutting, modification on torch and chemistry of cutting.
2. Metallic Arc Welding, metallic arc welding continued, principles of striking and maintaining an arc, power supplied, D.C. welding generator, A.C. welding transformer, other welding processes, electric resistance welding process.
3. CO<sub>2</sub> gas arc welding method and welding machines, argon gas arc welding method and welding machines continued. Characteristics of the arc. Testing of welds. Macro-etching. Slow bend test.

#### Workshop Practice

4. Safety in workshops. Introduction to the control of size on machine tools, e.g. precise movement of slide and tools. Measuring equipment - rulers, dividers. Micrometer, Vernier caliper etc. Sources of error due to forces acting, heat and lack of support. Use of simple plug and gap gauges. Marking out and production of profiles and hole centres to assist machining. General explanation of the combination of hand and machine works in typical components.
5. Explanation of geometric basis of machining processes. Solid objects as a combination of plane surfaces, circles and cylinders related to machine movement. Introduction to relationship between performance and geometry in the basic metal-cutting wedge. Explanation on how to use the drawing to make machine parts and assembly.
6. Fitting- Marking out, sawing, filing, clamping and drilling. Use of jigsaws and other modern equipment. Explanation of simple tools and cutters for typical machinery operation.

Drilling machine - drills, types and main parts. Laying out, setting up, care of drills, grinding, grinding theory, abrasives, grinding wheels. Off hand grinders, uses and operation, mounting wheels.

7. Lathe - main types, main parts and functions. Operations - between centres, face plates, chucks. Cutting tools, angles, shapes, materials. Other operations - threads, boring, drilling, knurling, cutting speeds and feeds and cutting external threads.
8. Shaping machine - main features and driving mechanism, how to use, clapper box and tools, machining inclined surfaces.

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9. Milling machine - type, functions of main parts. Various milling operations, gang milling, facing, profiling, indexing - milling cutters. Various adjustments, how to step and slot, feeds and cutting speeds.
10. Properties of materials, e.g. plain carbon steel, cast iron, plain brass, bronze and gun metal, etc.
11. Principles of sandcasting using wooden patterns and pattern plates with simple cores.
12. Soldering, brazing, fusion welding, riveting of the plates and bending and joining of water, gas and oil pipes.
13. Explanation of properties and use of insulating and conducting materials and electrical and electronic equipment. Explanation with wires and cables and wiring systems. Electrical connection diagrams, connections, joint and terminations. Insulation and safety precaution for marine electrical equipment such as excess current, shock, fire and explosion, corrosion and mechanical damages.
14. Tolerance and limits - flat surfaces, measurement. Dial indicators, slip gauges, reference blocks.
15. Limits - introduction to limits and interchangeability. Tolerances, clearances, interferences. Plug, ring, slip gauges, British standards. I.S.O. standards. Cutting tools - forces on tool, chips, coolants. Heat produced, clearances, high speed steel. Tools.
16. Batch production. Use of the Capstan lathe. Tooling and setting.

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FIRST YEAR

3.105 ELECTRICAL TECHNOLOGY

1. Electrical Circuits and Ohm's Law. Electrical Energy, Work, Power.
2. Conductors used in the electrical industry. Resistance controlled by dimensions and material. Insulators. Cables, cable size. Volt drop. Volt drop using the I.E.E. Regulations.
3. Elementary laws of magnetism. Effect produced when a current flows through a conductor. Elementary principle of the electric motor. Basic requirements of measuring instruments. Moving Coil Instruments, Moving Iron Instruments.
4. Faraday's Laws of Electromagnetic Induction. Direction of induced e.m.f. and current. Lenz Law. Self inductance. Mutual Inductance. Inductance in series and parallel. Capacitor. Capacitance in series and parallel. B-L-C Circuit. Reactance. Impedance. Power. Power Factor.
5. Quantity of heat. Electrical energy and heat. Heating methods - Resistance heating, Electric Arc and Induction Heating. Application - Instruments, Furnace and Welding. Effect of temperature rise on conductor resistance. Fuses, Rating and Fusing factor.
6. Primary and Secondary Cells. Lead acid cell. Batteries. Internal Resistance. Charging Secondary Cells and Batteries. Application - Automobiles. Two dissimilar metals. Heat indicating devices. D.C. Generator - separately excited and self excited (shunt, series and compound generator). A.C. Generator - single and three phase generator - construction - Output voltages and currents - vector diagrams of loaded alternators.
7. The Ideal A.C. One cycle of A.C. Mean Value. Effective Value. Form factor. Voltage and Current Relationship. Transformer. Transformer on open circuit. Transformer on load.
8. D.C. Motor - Self excited - shunt, Series and Compound motor speed control, characteristics of d.c. motor. A.C. motor - Induction Motor - single and three phase. Starters - Direct on - line starting. Star-Delta starting, Auto-transformer Starting.
9. Diode, Thermionic Valve, Power supply using rectifiers - half wave and full wave rectifiers. Transistors.

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FIRST YEAR

3.106 HEAT AND FLUID TECHNOLOGY

1. Work, Energy, Power. Forms of energy - units, mechanical and electrical energy. Conversion of energy, relationship between units - simple calculations. Revision of conduction, convection and radiation. Properties of and state of a system. Specific properties. First law of thermodynamics. Energy of a system as a property;  $Q - W = E$ . Terms involved in  $E$ : internal energy, Kinetic energy and potential energy. Definition of enthalpy. Choice of datum. Heat transfer through walls. Concept of a system, specification of its boundary.

Properties of Steam

2. Formation of Steam - relationship between pressure and temperature of formation, saturated steam, dryness fraction of wet steam, super-heated steam, Calorimetry.

Sensible heat, latent heat, superheat, Total heat (Enthalpy). Use of steam tables. Calculations relating to the total heat and specific volume.

Problems involving enthalpy - constant enthalpy processes, mixing of steam at different states.

3. Problems on boilers producing saturated and super-heated steam, boiler efficiency. Heat balance, Second Law of Thermodynamics.

Steam Engines

4. Reciprocating steam engines, steam turbines. P.V. Diagrams, Work done. M.E.P. Compounding, Power. Introduction to use of Entropy charts.
5. Chemistry of combustion. Analysis by weight and volume, calorific values. Methods of determining calorific values.
6. Cycles of operation for two stroke and four stroke engines based on compression ignition, spark ignition and hot bulb ignition. Calculation of power output and mechanical and thermal efficiencies of internal combustion engines.
7. Properties of air in relation to its compression, expansion, density, humidity and temperature.

Boyle's Law, Charles Law, Universal Gas Laws. Calculations of volume, pressures, temperature during compression, expansion.

Application of the first law to non-flow processes; constant volume, constant pressure, and adiabatic processes. Application of the first law to steady flow processes. Continuity equation and "Steady flow energy equation". Application to simple plant, e.g. boiler, compressor, turbine, nozzle, throttle.

FIRST YEAR

3.111 MARINE ENGINEERING PRACTICE

1. General introduction of Merchant ships - Functions performed by merchant ship, Development of waterborn crafts, kinds of ship, organization of personnel of an ordinary merchant ship, duty work and private life in merchant ships, adaptation to able seaman.
2. Guidance to merchant marine - principal particulars of merchant marine, general terms found or used inside merchant ships.
3. Summary of engine department - Works in engine department, Propulsion system, general arrangement in an engine room and their names, summary use of engines placed in a merchant ship, tank arrangement and uses of tanks, summary of pumping system (piping diagram) - kinds and uses of pumps, symbols on piping diagram, general piping arrangement on each fluids.
4. Summary of Navigation department - works in navigation department, nautical instruments and equipment - compass, log, sounding machines, other instruments - summary of Nautical technic - Rudder operation, Circulation ability, Staying, Bearing, Stations, Cargo handling, Co-operation works, symbols on nautical chart.
5. Summary of wireless department - works in wireless department, radio equipments and their resumptions, symbols on weather chart.
6. Equipment and stations concerned to casualty and safety-keeping on a merchant ship - equipment and tools in an emergency use, necessary and important works in casualties, prevention stations against casualties.
7. General notice and important mission in engine department - general attentions on embarkation, matters to be reported to the chief engineers, summary of navigation and staying watches, log book writing, warming up and cooling down engines, necessary works on and against stormy sea, necessary works on and against frozen sea.

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Specific heats at constant pressure and constant volume and their relationship. Expansion and compression of air. Adiabatic and Isothermal process. Air standard cycles. Internal energy and external work. Efficiencies of cycle. Entropy and entropy charts. Partial pressures. Daltons Law.

Kinetic theory of gases, concept of perfect gas, gas constant and units, universal gas constant, relationship between specific heats and gas constant. Mixtures of gases, proportions by mass and volume. Conversion from mass to volumetric analysis and vice versa.

Explanation of reversibility and irreversibility. Significance of area under the path on a pressure-volume diagram. Evaluation of specific heat and gas constant for a mixture of perfect gases. Behaviour of real gases compared with the perfect gas.

Properties of real fluids and general phase diagrams. Wet, dry saturated and superheated states. Representation of properties by tabulars and graphs.

Representation of the state of a system by property diagrams, pressure, specific volume, temperature, internal energy, enthalpy and simple idea cycles.

8. Definition of a heat engine. Efficiency, reversed heat engine. Carnot principle. Impossibility of 100% of efficiency. Analysis of maximum efficiency of heat engine.
9. Expansion and compression. Work done, Multi-stage Compression. Efficiency.
10. Fluid-properties, density, specific volume. Pressure-depth relationship, pressure distribution of fluid at rest. Center of pressure. Condition for equilibrium of a floating body, metacentric height.
11. Flow measurement - orifice plate, venturimeter, Kinematics - streamlined flow. Continuity equation. Bernoulli equations, floating energy grade lines.

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FIRST YEAR

3.112 NAVAL ARCHITECTURE

1. Introduction. Development of ship. Sea, peculiarity of sea water, wave of sea, current, tides, wind.
2. Kind of ship. Classification by purpose, e.g. merchant ship, passenger, cargo, etc. Fishing boats, catcher boats, fish carriers, etc. Warships, battleships, cruisers, etc. Special boats, salvage, dredgers, etc. Classification by type of vessel. Flush deck, three islander, well deck vessel.
3. IMCO. International Conventions. Safety of Navigation. Life saving appliances. Search and rescue manual. Training of guidance, Safety of life at sea. Safety of fishing vessel. Classification society.
4. Principal terms used in Naval Architecture, length between perpendiculars, draughts, etc. Block, prismatic, midship section area. Water plane area coefficient. Fuel consumption. Speed of ship.
5. Tonnage. Measurement of tonnage. Gross and Net tonnage. General terms used in tonnage measurements. Relationship between various tonnages. Freeboard. Definitions. Need for adequate freeboard. Load line marking.
6. Stress in ship structure. Longitudinal and transverse bending. Sagging and hogging.
7. Ship construction. Names of parts of ship, Principal structural members and their attachments section, welding and rivetting. Construction of all parts of ships. Double bottom, framing, plating shell and decks. Beam and deck girders. Hatches. Bulkhead and deep tanks. Fore end arrangement. After end arrangement. General description of ship types. Oil tankers. Bulk carriers. Special carriers.

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SECOND YEAR

SECOND YEAR

3.204

MECHANICS OF MACHINES

1. The principle of static equilibrium for co-planer forces, graphical determination of forces in simple framed structures. Analytical and graphical conditions of application problems of equilibrium. Application to frame structures. Application to fluid at rest, total thrust, centre of pressure.
2. Newton's laws of motion and their application to uniformly accelerated linear and uniform angular motion.
3. Friction-revision. Friction in screws-vee threads. Brief description of theory of lubrication. Friction in clutches and pivots. Belt and rope drives. Vee belt and rope drives
4. Theory of bending-proof of relationship,  
$$\frac{\delta}{y} = \frac{M}{I} = \frac{E}{R}$$
 and applications.
5. Theory of torsion-proof of relationship,  
$$\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L}$$
 and applications.
6. Gear trains-simple. Gear trains-compound. Epicyclic gears. Torque and power in gears.
7. Vibrations, simple harmonic motion. Vibrations in compound springs-effect of spring weight. Transverse vibration-torsional vibrations. Compound pendulum. Introduction to damped and forced vibrations. Introduction to cams-uses. Drawing and construction-cam design.
8. Balancing of rotating masses - one plane. Balancing of rotating masses - two or more planes. General dynamics, the concepts of energy momentum and inertia, etc.
9. Vehicle dynamics. Flywheels-fluctuation of speed and energy. Problems on flywheels. Velocity diagrams-velocity vector method. Velocity diagrams. Instantaneous centre method. Acceleration diagrams. Vector method. Continuation of acceleration diagrams. Forces in link mechanism-velocity of rubbing.
10. Impact of jets on fixed vanes. Centrifugal forces and their application to simple co-planar balancing.
11. Flywheel and fluctuation of energy. Function of flywheel-fluctuation of energy-fluctuation of speed-flywheel design.
12. Belt and rope drives. Introduction to drives-calculations of ratio of tensions in belts-centrifugal tension-maximum power transfer.

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## SECOND YEAR

### 3.201 STRENGTH OF MATERIALS

1. Simple atomic structure. The electron, proton and neutron. The periodic table and valency. Isotopes. Process of ionisation, plus and minus ions. Ionisation current. Excitation and ionisation by collision. Discharge through air at low pressure. Cathode rays. Release of electrons by heat, light, particle bombardment and the action of electric fields. Deflection of an electric beam in electric and magnetic fields. Cathode ray tube, electrostatic and magnetic focussing. Radioactivity. Half-life. Qualitative description of, and radiation. Detection and counting of ionising particles, cloud chamber, counter and photographic plate. Shielding and radio-logical safety precautions. Applications of radioisotopes.
2. Revision of mechanical properties: terms used. Hooke's law. Stress-strain. Familiarisation with British and Metric units. Non-destructive testing. Magnetic flow detection. Stress strain diagrams. Introduction to the load-extension diagrams to fracture and to yield and ultimate stress. The concept of safety factors. Proof stress, Poisson's ratio, etc. Introduction to electrical resistance strain gauges. Compound manometers and simple pressure gauges, calibration of gauges and sources of error. Uses in electrical resistance strain gauges, work done by variation pressure, indicator diagrams.
3. Bending moment and shear force diagrams. Hardness testing, Vickers, Brinell, Rockwell. Continuation with bending moment and shear force diagrams. Bending stresses in beams, Evaluation of second moment of area. Micro hardness testing. Strain energy in bending. Use of Shore Schleroscope for hardness testing of different materials.
4. Deflection of beams. Analytical Macaulay's method. Estimating Young's Modulus by bending. Deflection continued. Mohr's diagram. Strain energy.
5. Torsion of shafts. Strain energy in torsion. Estimating Modulus of rigidity for different materials. Impact loads. Axi-symmetrical systems.
6. Thin cylinders, thick cylinders, X-ray techniques. Struts and columns. Struts and columns continued. Springs, close-coiled helical springs.
7. Struts and columns. Introduction; the Euler crippling load; Buckling of a pin ended strut; Pin ended struts with eccentric end thrust.
8. Further bending of beams. Deflection by Macauley's method; Deflection by method of superposition; combined bending and direct stresses.
9. Stress-strains transformations and relationships. Introduction, symbols and signs; stresses on a plane inclined to the direction of loading; element subjected to direct stresses in two perpendicular directions; shearing stresses only; and general two dimensional stress system; Mohr's circle; Principle stresses and planes.

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SECOND YEAR

3.222

STEAM ENGINEERING

1.

BOILER

1. Introduction - Classification of boilers-cylindrical boiler, water tube boiler and special boiler.
2. Capacity and efficiency of boilers - Equivalent evaporation, boiler horse power, boiler rating, rate of heat generation, rate of vaporization and boiler efficiency.
3. Steam, fuel and combustion - Review with steam properties. Classification of fuels, liquid fuels, heavy fuel oils and fuel oil additives, calorific value. Combustion theory, theoretical combustion air required, excess air, combustion gas volume. Troubles by the combustion product, low temperature corrosion, high temperature corrosion.
4. Heat transfer - Kinds of heat transfer, conductivity, convection, radiation, heat transmission, overall coefficient of heat transmission, heat transfer to a boiling liquid.
5. Construction of boiler - Boiler shell, end plate, furnace, combustion chamber, smoke tube, stay, water tube, superheater, de-superheater, manhole and mud hole, steam drum, water drum, header, combustion chamber wall, man wall (water wall, boiler casing, boiler bed, boiler water circulation pump and forced circulation boiler, forced through flow boiler, special boiler).
6. Boiler fittings and mounting - Kinds of fittings and mountings, detail of: superheater, de-superheater, reheater, economizer, air preheater, safety valve, water level gauge, steam stop valve, feed water check and stop valve, scum pan, scum and blow down valve, salinometer valve, pressure gauge, soot blower, steam pipe.
7. Combustion devices - Fuel supply system, classification of burners.
8. Draft - Classification of draft, draft force by chimney, draft resistance and draft force, draft fan.
9. Boiler water treatment - Indication of impurities in the water, unit, hardness of water, Alkalinity, PH, Kinds of impurities, gases in the water, kinds of corrosion, dissolved salt compound, alkali corrosion and sodium embrittlement, boiler scales, carry over, primary boiler water treatment, use of distilled water, ion exchangeresin, use of deaerator, secondary boiler water treatment, boiler compounds, Standard of boiler water.
10. Running and maintenance of boilers - Properties for rising steam, set fire, general precaution during rising steam, inspection of boiler.



11. The reasons of the use of the superheater, the desuperheater and the attemperator. Control of the superheated steam temperature.
12. The boiler water treatment of the high pressure and high temperature boiler - Low PH treatment and caustic treatment.
13. Automatic combustion control - Pneumatic and electric.

## II. STEAM TURBINE

1. Introduction, Fundamental of steam turbine - History of Marine steam turbine, advantages and disadvantages of steam turbine, concept of steam turbine, classification of steam turbine. Impulse turbine; single stage impulse turbine, pressure compound impulse turbine, velocity compound impulse turbine, Pressure velocity compound steam turbine, Reaction turbine; axial flow reaction turbine, radial flow reaction turbine, Combined turbine, Specialities of marine turbine, Review of simple thermodynamics, properties of steam, pressure drop and heat drop, steam table and steam chart.
2. Details of structure - Structure of rotors and materials. Balancing of rotor; statical balancing and dynamical balancing. Nozzles; steam flow in the nozzle, shape of nozzle, kinds of nozzles. Kinds of turbine blades, materials, blading, shroud ring, pitch of blading and blade tip clearance, turbine casing sentinel valve, diaphragm, Labyrinth packing, Carbon packing, Packing steam system. Journal bearing, Thrust bearing, Astern turbine, necessity of astern turbine, arrangement of astern turbine, structure of astern turbine, Reduction gear, factors required as good reduction gear, tooth form, arrangement, materials and structure of reduction gear.
3. Speed control system and emergency devices - throttle governing, nozzle control governing, emergency governors.
4. Losses and efficiencies - Internal losses and external losses, stage diagram efficiency, stage internal efficiency, mechanical efficiency, effective efficiency, thermal efficiency, total thermal efficiency of propulsion engine plant.
5. Auxiliaries - Condenser, condensate pump, air ejector, gland condenser, draincooler.
6. Shaft line and stern tube-shaft line, intermediate shaft, propeller shaft, cooling system of shaft line.
7. Turbine theory - Nozzle theory, convergent and convergent-divergent, velocity compounding, pressure compounding, stage efficiencies. Velocity diagrams for impulse and reaction turbines, Theoretical constructions of impulse and reaction blades. Reaction principle.

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SECOND YEAR

3.223 AUXILIARY ENGINEERING

I. Pumps

1. Review of Hydraulics concerned - Mean velocity of flow, Equation of continuity of flow. Stored energy of fluid. Bernoulli's theorem.
2. Theory of pump - Principles, Heads of pump, Powers, Efficiencies.
3. Reciprocating, Rotary, Centrifugal and Variable discharge pumps - Structures, characteristic curves, flow rate adjustment, operations, maintenances.
4. Routine servicings - Weir's pump, Worthington pump, Hele Shaw pump, William Janney pump, Fire pumps.

II. Steering Gears

1. Types of steering gear - Prime-mover, controlling gear, rudder gear, hunting gear.
2. Safety devices and emergency gears.
3. Electro-hydraulic and electric steering gears - structures, operations, maintenances, charging, testing and change over procedures for electro-hydraulic system.
4. Automatic steering gears.

III. Air compressors

1. Theory of compressor - Isothermal and isentropic compression and efficiencies, effect of clearance, calculation of work done, multi-stage, compression and intercoolers.
2. Reciprocating and rotary type compressors, coolers and air reservoirs. Structures, operations, maintenances.

IV. Purifiers

Purifying principle, types of purifiers, structures, operations, maintenances, self-cleaning purifiers.

V Oily water separators

Principle, structures, operations, maintenances. "Oil in Navigable waters Acts".

VI. Deck Machineries

Cargo handling gears, cargo winches, cargo cranes, windlasses, mooring winches, capstans.

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## VII. Refrigeration and Air-Conditioning

1. Review of thermodynamics concerned - transmission of heat, 1st and 2nd law of thermodynamics, internal energy, enthalpy, entropy, reversible change of state of gas, reversed Carnot cycle.
2. Theory of refrigeration - Vapour compression cycles, refrigerating effect, ton of refrigeration, coefficient of performance, efficiencies, P-i and T-S diagrams, calculation of cycles with diagrams.
3. Refrigerants - Kinds and properties of refrigerant and brine, leak detect.
4. Cargo and domestic refrigerating plants - structure of reciprocating and rotary compressors, condensers, evaporators, Safety devices.
5. Operations and maintenances - Testing, charging and pumping down, defrosting, automatic operations, refrigerating chambers, cargo carrying temperatures, cargo acceptance and stowing, refrigerating containers, routine servicing and malfunctions of vapour compression refrigerator.
6. Air-conditioning plants (cargo and domestic).

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1. Introduction to different types of automatic control, controller units and correcting units, open loop and close loop with application to temperature, pressure, and level control. Time element - first order and time lags. The time constant. Pressure load, system response of step, ramp, sinusoidal input to single capacity system. Control units parallel arrangement, gain factor.
2. Pressure Measurement. Manometers, simple U-tube, industrial U-tube, differential, inclined tube, two liquid U-tube. Ring balance manometer. Operation of diaphragms, capsules and bellows for pressure measurement. Industrial applications. Operation of Bourdon tubes, C-types spiral and helical. Application of pressure switches. Pressure alarm and electrical transmission for annunciator light and warning systems. Static head correction. High vacuum measurement, MacCloud Gauge, Pirani Gauge, Cathode Ionization Gauge, Magnetron Gauge, Types of pressure recorders and their functions and arrangement. Control circuit of pressure measuring devices. Introduce air supply for transmission. Use of filter, regulator. Demonstrate pneumatic pressure transmitter and receiver pressure gauge. Air purge and bubbler systems. Range suppression on pressure head meters, correction and calculations. Use of seal and condensate chambers. Differential pressure instruments.
3. Flow Measurement. Application of Bernoulli's theorem, differential pressure flowmeter, orifice pattern, use of manometers with orifice plate and venturi to measure flow, venturi and nozzle pattern, pilot tube pattern, Dall tube pattern, variable area flowmeters, displacement and differential flowmeter. Electromagnetic flowmeter, ultrasonic flowmeter, anemometer, integrators, recorders. Installation of measuring instruments, square law effect and methods of correction.
4. Level Measurement instruments. Use of pressure measuring instruments for liquid level measurement. Displacement gauges, float switches, external float gauge instrument, electrical probe for liquid level measurement. Use of pressure switches with alarm contacts and electrical transmission for annunciator lights and warning systems. Use of strain gauges with bridge circuits. Scanning of several measurements and switches with multiplex of signal for remote reading.  
  
Liquid and solid level measurement, sight glass, Ekstrom gauge, float gauge, liquid manometer instrument, sight Diaphragm. Diaphragm stack or bellows, instruments, fluid purging system, Buoyancy or torque tube. Capacitor type, Nucleonic type, weighting type. Pulls transmission. Control circuit for level measurement.
5. Temperature Measurement. Non-electrical thermometer, liquid expansion type, gas expansion type, vapour expansion type, Bil-metallic type. Electrical thermometer, thermocouples, law of intermediate temperatures, metals, hot and cold junctions, positive and negative wires. Resistance thermometer. Semiconductor thermometer, hull-balance instrument, Radiation pattern thermometer, or Pyrometers - photo cell and optical pyrometers, measuring circuit, control of temperature, detecting devices, multi-point installations.

6. Moisture and PH Measurement. Wet and dry bulb, sling hygrometer, mercury-in-steel hygrometer, hair hygrometer, gregory hygrometer. Dowcel hygrometer, Casella Alnor hygrometer, Electrolytic hygrometer. Ionic dissociation, PH scale, British Standard, PH scale and definition, hydrogen, glass, calomel, electrodes.
7. Viscosity measurement.
8. Humidity and moisture measurement.
9. Measurement of carbon dioxide.
10. Miscellaneous meters, Tachometers, torsionmeters, power meters.
11. Introduction to pneumatic control. Use of position balance and force balance pneumatic and pneumatic electrical controllers. Falpper-nozzle type or "stack-type" pneumatic controllers with proportional plus integral and proportional plus integral plus derivative control, linear and square root charts. Proportional action, proportional band, offset. Proportional plus integral control, integral action time. Use of motor point potential metric indicators and for inductive, capacitive, resistive strain gauges and others, signal conversion. Introduction to power hydraulic circuits: symbols and components, simple circuit design, pneumatic relays, bleed type, non-bleed type.
12. Pneumatic Circuits using automatic control. Industrial applications, units and symbols, design of simple pneumatic circuits. (Hydro-pneumatic system and devices). Introduction to set theory and Boolean Algebra. Subset, Equality of sets, Universal set, empty set, Venn diagram. Application to switch circuits (and pneumatic system).  
Logic Theory: AND, OR, NOR, NAND circuits, combinational logic and sequential logic.
13. Flow Measurement in Open Channels. Rectangular type weir, V-notch or Thomson Weirs, Trapezoidal or Chipplatti weir, Suppressed weirs, installation to weirs, Venturi flumes, measuring instruments.
14. Control valves and transmitters. Description of the basic elements and construction.
15. Applications
  - (a) Use of strain gauges with bridge circuits. Scanning of several measurements and switches with multiplexing of signals for remote reading. Use of compensating cables. Use of multi-point potentiometric indicators and recorders.
  - (b) Applications in Marine Engineering: viscosity control of fuel oil, feedwater controls, deaerator controls etc. Operation and maintenance of marine control equipment.

SECOND YEAR

3.225 MARINE WORKSHOP TECHNOLOGI

1. Materials - Basic composition. Physical properties and typical engineering uses of the following materials - Plain carbon steels, plain brass, bronze and gun-metal, Ni-steel, Ni-Cr-steel. Basic Al base alloys. Common bearing metals, common Zn base and Al base die-casting alloys. High duty, malleable and SG cast irons. Common high speed steels, sintered carbides for cutting tools. Common thermosetting and thermo-plastic plastics, P.V.C., nylon and glass-fibre.
  
2. Heat treatment - meaning terminology, and uses. Heat-treatment on steels, referring to the Fe-C system. Heat-treatment on steels continued. Annealing, Normalising, Sphercidising, T.T.T. curves and harden ability, hardening and temperaing. Harden ability and quench cracking. Purpose of working processes, effects and cold working, hot working and annealing. Mechanisms of deformation, role of crystal boundaries, deformation of poly-crystals.  
  
An outline of the effects on properties and response to heat-treatment of Ni, Cr, Mo and Mn in steel, including temper-brittleness. Al alloy treatment. Local hardening by case-carbonizing and local heating.
  
3. Basic Forming Processes - Gravity and pressure methods of die-casting. Die cast products - Their machining. Investment moulding. Introduction to press tool work. The sand-casting process and its extension by the use of pattern plates. Injection and transfer moulding of plastics, hot and cold forging, Rolling and extrusion, Introduction to the principles of blanking, punching and bending with simple press tools.
  
4. Metal Forming by cutting - An elementary treatment and analysis of the relations between tool geometry, cutting forces, power consumption and tool life. Identification of essential tool angles in single point tools, drills and milling cutters.  
  
Explanation of the essential, generating function of metal cutting machine tools and derivation of accuracy from machine geometry. Simple analysis of the geometry and range of functions of the centre-lathe, drilling machine, milling machine and cylindrical grinder. Sources of error and normal expectation of accuracy. Line diagram explanation of basic transmission systems for the above machines. Method of holding typical work pieces. An outline of typical machining methods, including simple vee threads, elementary process planning, consideration of production times, floor to floor times, and cost of production in relation to machining methods.
  
5. Dimensional control - Principles of interchangeability, Basic principles of the British Standard System: gauging by, fixed size, adjustable and indicating gauges. Principle of comparative measurement, typical mechanical comparators and their uses, calculation and accuracy. Simple consideration of the cost of increasing accuracy. Applications of B.S. system in measurement. Use of dial indicator, optical projector and preparation and use of typical master forms.

6. Revision of gas welding and cutting AC and DC welding resistance welding and submerged arc and inert gas welding. Types and classification of electrodes. T.I.G. and M.I.G. welding.

Details of butt and lap joints. Comparison between welding and riveting. Common faults. Methods of testing welds. Ship's classification society requirements with welding sequence and pre-fabrication. Scallopig, Slip gauges and comparators. Cutting tool froces and surface finish. Sintered carbide tools. Hydraulic profiling on lathe. Grinding machines. The abrasive wheel. The auto collimator and angle dekkor.

7. Screw thread measurement. Milling - slotting. Cutters and dividing head and construction. Methods of indexing - direct, simple angular. Differential indexing - spiral. Milling. Drilling machines, horizontal boring machine.
8. Capstan turret lathe. Standard tools. Planning and setting. Capstan lathe; tool layouts. Programmed machining. Advanced operations on lathe. Turning of large work; setting and operation times.
9. Surface finish - comparison. Lapping, honing and super finishing - their characteristics. Co-ordinate machine, principle of jig boring, numerical controlled machine tools. Work lag and sequence of control. Heat treatment and salt bath furnaces.
10. General notice, important mission and maintenance work in engine department - General attentions on embarkation, Matters to be reported to the chief engineer, Summary of navigation and staying watches, Log book writing, Necessary works on and against stormy sea, Necessary works on and against cold sea, sea contamination, Necessary measure against engine trouble, Necessary work by which the engine is kept in good condition during a long stay in port. General notice for loading.

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SECOND YEAR

3.226

NAVAL ARCHITECTURE

1. Common terms used in Naval Architecture O Length between perpendiculars, breadth moulded, breadth extreme, draughts depths, sheer, etc. Definition of shipbuilding terms in general use. Lines plan. Coefficient of form. Block, mid-section area, prismatic and water plane area coefficient.
2. Areas. Volumes. Moments. Displacements. Commonly used rules for finding areas of trapezoidal, mean ordinate, Simpson's 1st, Simpson's 2nd and Tchebycheff's Rules. Application of Simpson's Rules to volume, displacement. Other methods for calculation of displacement. Tonne per centimetre immersion. Change of draught caused by flooding at amidship, at sea and river water. Wetted surface area. Approximate formula of wetted surface area.
3. Stability - Centre of gravity. Centre of Buoyancy. Method for obtaining the centre of gravity by means of Simpson's Rules. Centre of buoyancy. Moment of inertia of a simple figure. Method of acquiring the moment of inertia of a curved figure against base line. Approximate equation. Moment of inertia of water plane about the centre of floatation.
4. Transverse stability. Transverse metacentre and metacentric height. Stability at small angles of heel.  $B.M. = \frac{I}{V}$ . Inclining experiment. To obtain the metacentric height of a ship. Free surface effect and sub-division of tanks. Suspended weights - Fuel and water effect of filling and emptying tanks.
5. Longitudinal stability. Longitudinal  $\overline{GH}$  and  $\overline{BM}$ . Sample calculation. Approximations for longitudinal metacentre. Trim and change of trim. Longitudinal inclination by means of longitudinal shift of weights. Moment of change trim by one cm. Change of draught and trim due to the addition, removal or movements of weights. Change of trim and draught due to flooding of compartment. Docking. Docking stability.
6. Statical stability and stability curve. Statical stability at large angle of heel. Moment of statical stability. GZ curves. Cross curves of stability.
7. Stabilisers and stabilising systems. Six degrees of freedoms of ship's movement. Natural roll period. Fin stabiliser. Tank stabilisers.
8. Resistance and powering of ships. Sort of resistance - Frictional, wave-making, eddy making and air resistance.  $R_f = fSV^{1.825}$ . Total resistance. Model experiment and effect of size. Froude's Law of Comparison. Factors effect to resistance of ship. Powering of ship. Effective horse power. Admiralty coefficient, Fuel coefficient, fuel consumption. Taylor's standard series. Towing tanks and model tests. International Towing Tank Conference Line.



9. Propeller and propulsion. Kinds of propellers. Kinds of screw propellers. Terms for screw propellers. Theory of screw propellers. Calculations of slip. Relation between power and the use of  $e_p$ ,  $d_p$ ,  $QPC$  etc. in problem on propellers. Construction and material of screw propeller. Relation between power, mean pressure and speed. Measurement of pitch of propeller. Cavitations.

SECOND YEAR

3.227 ELECTRICAL TECHNOLOGY

1. DC Machine  
DC Generator - types, series, shunt, compound. Construction. Operation, windings, lap, wave. Commutator. Armature reaction, em.f. equation. Self-excitation. Different types of calculation. Characteristic graph.  
  
DC Motor - types series. Shunt compound motor. Construction. Operation. Starter. Speed control. Characteristic graph. Applications. Efficiency. Calculation.
2. AC Induction Motor.  
Single phase A.C. motor - types construction, operation, circuit diagram, application.  
  
Three phase A.C. motor - types - squirrel cage and wound rotor. Construction, production of a rotating magnetic field, method of starting - Star-delta. Types of starter, characteristic graph, torque-slip, torque/speed, torque/rotor resistance. Equivalent circuit, power flow chart, calculation.
3. Transformer - single phase transformer, construction and operation; Magnetising and load currents; Phasor diagram; Equivalent circuit; Open and short circuit test; Efficiency; Loading condition; Voltage regulation calculation.
4. Synchronous machine - construction and operation; method of starting and synchronization; effect of loading and excitation; application - power factor correction.
5. Alternator - construction and operation; types of rotor; characteristic; calculation; application.
6. Distribution of electricity.  
  
AC distribution - single phase power circuit, three phase power circuit, star/delta connection, power factor.  
  
DC distribution - 2-wire system, 3-wire system, wire size calculation, voltage drop calculation.  
  
Typical marine power distribution system.
7. Magnetic Control - Magnetic contactor for A.C. machine. Magnetic control; overload, no volt in electrical machine. Automatic control; ship propulsion; electric steering.
8. Measurement - 1 wattmeter method, 2 wattmeter method, universal test meter, air-coredynamometer, extension of meter range.
9. Electronics  
Electronics valve - introduction, principle of operation of vacuum tubes, diode, triode, pentode, symbol.  
  
Semiconductor devices - introduction, types and structure - diode, transistor, silicon control rectifier, Symbol, general application.

SECOND YEAR

3,228 INTERNAL COMBUSTION ENGINEERING

1. Comparison between spark-ignition engines and compression ignition engines - advantages and defects of diesel engines.
2. Four cycle diesel engines and two cycle diesel engines - Outline of operation. Comparison of principal characteristics. Selection between four cycle and two cycle. Timing.
3. Types of diesel engines - Classification of types. Selection of types.
4. Thermodynamics of internal combustion engine - Basic terms in I.C.E., Laws concerning perfect gasses. Fundamental laws of thermodynamics. Specific heat of gases. Change of state of Gases. Actual change of the gasses in cylinder. Theoretical air standard cycles - Otto cycle, Diesel cycle, Sabathe (Dual) cycle. Comparison of thermal efficiency of three kinds of "standard cycle". Fuel-air cycle. Actual conditions in cylinders. Kinds and definitions of respective thermal efficiency. Kinds and definition of mean pressure. Fuel consumption. Heat balance.
5. Theory of combustion - Fuel. Combustion equations. Air required for combustion. Limit of combustion. Ability to be ignited of gasoline, Gasoline knock. Octane number. Ability to be ignited of diesel oil. Ignition lag. Diesel knock. Cetane number. Combustion process in gasoline engine. Combustion process in diesel engine. Analysis of the product of combustion. Handling of gas guels. Handling of volatile liquid fuels. Handling of fuel oils.
6. Cylinder pressure indicators and indicator diagrams - Utilities of pressure indicator. Kinds of pressure indicator. Driving gear for operating drum of pressure indicator. Cautions when taking indicator diagrams. Method to obtain indicated horsepower. Method to obtain mean indicated pressure. Diagrams for other specified purposes.
7. Main constructional parts of diesel engine - Drawings of general construction of diesel engines (examples). Main fixed parts of diesel engines-cylinders and cylinder cover, frames, bedplates and engine beds, main bearings. Main moving parts of diesel engines-piston-trunk type piston, crosshead type piston, piston rings, piston rod, crosshead guide shoes and guide plate, connecting rods and their upper and lower bearings. Crankshafts, Kinds of crankshafts and their construction. Arrangement of cranks and firing order of cylinders. Lubricating system. Cooling system. Air starting and reversing systems. Crank case safety devices. Gearing and drives governors; Auxiliary plant modules.
8. Vibrations and balancing - Reciprocating parts. Harmonics. Methods of analysis - single cylinder, two cylinder, multiple cylinder engines. Counter balancing - balancing of harmonics, cynchronous vibration. Twisting system. Torsional vibration. Vibration nodes. Order of vibrations. Minor and major critical speeds. Additional stresses. Repeating twisting stress. Wear down of bearing. Crank arm deflection. Method to measure crank web deflection. Balancing weight, flywheel.

9. Recharging process inside cylinder - Recharging process inside cylinder in 4-cycle diesel engine. Air intake devices of 4-cycle diesel engine. Exhaust devices. Utilization of waste heat pipe, valve, silencer. Volumetric efficiency and charging efficiency in 4-cycle diesel engine. Scavenging process in 2-cycle diesel engine. Scavenging process in symmetrical scavenging. Types of scavenging in 2-cycle diesel engine. Scavenging air supply devices in 2-cycle diesel engine. Scavenging efficiency and trapping efficiency in 2-cycle diesel engine.
10. Supercharging diesel engine - Supercharging. Method of supercharging. Exhaust turbo supercharger - construction. Surging zone. Utilization of exhaust gases. Dynamics pressure supercharging. Static pressure supercharging. Pressure variation in exhaust pipe and combination of exhaust pipes. Main modification points when natural aspiration engines are converted to the supercharged engines with exhaust turbine superchargers.
11. Fuel injection system - Kinds of fuel injection system. Kinds of fuel injection pump. Airless injection fuel pump. The Bosch fuel pump. The Sulzer fuel pump. Bermeister and Wain fuel injection system, the common rail fuel injection system. Fuel pump driving cams. Airless injection fuel valves. High viscosity fuels.
12. Materials of construction and corrosion - Carbon. Silicon. Manganese. Phosphorus. Sulphur. Tensile strength, hardness. Cast iron bedplate which have composition and mechanical property. Columns which have composition and mechanical property. Cylinder beams which have composition and mechanical property. Cylinder crosshead guide bars which have composition and mechanical property. Cylinder liner, pistons, piston rings, exhaust valves, crankshafts, connecting rods, piston rods, crossheads, bearing bolts, through tie bolts, camshafts, crosshead guide shoes. H.P., Fuel pump. Fuel valves. Compressed air valves and seats.
13. Performance of diesel engines - Indicator diagrams. Mean effective pressure and indicated power output. Shaft power output. Mechanical efficiency and brake mean effective pressure. Thermal efficiency and heat balance diagram. Fuel consumption. Other main items of measurement, record of results and performance curves of operation. Performance test.

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FINAL YEAR

FINAL YEAR

3.501 MECHANICAL TECHNOLOGY

1. Stress in oblique planes induced by (a) Single direct stress, (b) two direct stresses at right angles, (c) complementary shear stresses. Calculation of strain energy in tension and in torsional shear. Impact loading of tie rods and springs.
2. Equilibrium of governors, central and spring loading, sleeve friction.
3. Relations between loading, shear force, bending moment, slope, deflection. Calculation of deflection in cantilevers and simply supported beams by Macaulay's method. Combined bending and direct stress, eccentric loading of short columns. Struts, derivation of Euler formula, development of Rankine formula.
4. Fundamental torsion equation. Relationships between torque, stress and power. Coupling bolt. Further work on torsion in solid and hollow shaft. Coiled helical spring.
5. Dynamics for piston-crank mechanism. Calculation of piston displacement, velocity and acceleration for the reciprocating engine mechanism. Use of displacement time and derived curves for design of cams.  
  
Application to design and analysis of screw thread, thrust bearing, plate and cone clutches.
6. Natural frequency of springs and shafts. Examples of resonance including whirling. Torsional vibration of shafting. Critical vibration of engines. Vibration on steam turbine. Prevention of vibration on marine engine.
7. Balancing. Static and dynamic balance. Balancing of masses rotating in different planes. Dynamic forces at bearings.
8. Positive displacement pumps. Centrifugal pumps. Use of principles of relative velocity and of fluid flow over moving vanes to determine work, power and blade efficiency of centrifugal pump.

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FINAL YEAR

3.502 INTERNAL COMBUSTION ENGINEERING

1. Revisional applied heat - Important definitions of thermodynamical terms and their units, energy equation, Definition of a heat engine, Carnot principles, First and Second Law of Thermodynamics. Comparison of Otto, Sabathe and Diesel cycles.
2. Entropy - Property diagrams incorporating the property entropy, comparison of diagrams (P-v, T-S, i-s), Equilibrium process in terms of the parameters of state.
3. Ideal cycles - Characteristics of dual combustion cycle and ideal simple processes. How to use state diagrams, Properties of isothermal, isovolumetric, isobaric and isentropic changes, air standard efficiency.
4. Combustion - Combustion Equations, Exhaust and flue gas analysis, Practical analysis of combustion products, Internal energy and Enthalpy of combustion.
5. Internal Combustion Engines - General design and construction of major types sulzer, B & W, MAN, GV, UEC etc. Fuel system for high viscosity fuels; Cautions how to use them with their properties, viscosity curves. Actual cycles; Revision of indicated and brake powers. Revisions of efficiencies, Gross and specific fuel consumption. Energy balance. Comparison of Performance Curves between supercharged and nonsupercharged engines.

Actual technique; measurement of crankweb deflection and adjustment of crankshaft alignment. Procedures of dismantling and assembly of vital parts. Injection and fuel pump testing, Examination and Timing diagrams, Power, Out-of-phase and light spring diagrams, measurements of power, Sampling and testing of lubricating oil and fuel. Special technique of maintenance and repair works, Emergency operation technique.

6. Gas turbines - Revision of turbo supercharger; Types of supercharging, Increment of power, surging, gas turbine cycles. Free piston turbine, Ideal cycle, Efficiency, Constructional view, Revisions and problems. Auxiliary open cycle gas turbine; Ideal cycle, Efficiency, Constructional view. Open and closed cycles; Ideal cycle, Efficiency, revisions and problems. Basic cycle; calculation of work and power.

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FINAL YEAR

3.503 PURE MATHEMATICS

1. Algebra - Fitting equations to experimental data, linear form and those reducible to linear form. Use of log-linear and log-log paper. Use of the binomial expansion for any real index.
2. Trigonometry - Superposition of Sine waves. Reduction of  $a \cos \theta + b \sin \theta$  to the form  $R \cos (\theta - \phi)$  etc.
3. Differentiation - Differentiation of a constant,  $ax^n$ , sum and difference, function of function, trigonometric function,  $e^x$ ,  $\ln x$ , of a product, quotient, implicit function. Partial, Higher derivatives. Application as rate measurer. Kinetics. Approximations. Maximum, minimum and curve sketching.
4. Integration - Integration of  $ax^n$ , sum and differences. Substitution methods. Standard forms. Trigonometric functions. Algebraic fractions, by parts. Definite integration. Application of area under a curve, volume of solids of revolution, centre of gravity and centroid.
5. Simple differential equations - Complementary function and particular integral. Solution of first order equations. Examples in measurement and control.
6. Partial fractions.
7. Laplace transform - Use of tables of transform. Solution of first and second order of measurement and control problems.
8. Elementary linear algebra - Determinants. Matrices.
9. Vectors - Definition. Addition and subtraction of vectors. Products of vectors. Vector equation of a straight line.

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FINAL YEAR

3.504 DRAFTING & DESIGN

1. Drawing

1. Drawing examples requiring the use of typical drawing office. Standard parts lists, commercial standards parts and components such as bearings and fastenings, liquid and gas seals, and other bought-out items.
2. Familiarisation with common engineering components, safety valves of marine boilers; flexible coupling for turbines, starting air-valves for diesel engines, etc.
3. Classroom exercise on assembly drawing of complete marine machinery.

11. Design

1. Simple design framed around a principal manufacturing process, e.g. casting, fabrication, machining, sheet forming, plastic moulding, problems of emergency repairs, recognition of causes of failure.

Exercises in re-design for fewer parts, greater ease of manufacture, improved operation casts reduction and change of material or technique.

2. Practical analysis and design of simple single components, key and keyways, etc.
3. Extraction of information from catalogues and specifications.

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FINAL YEAR

3.505 STEAM ENGINEERING

1. Steam power cycles - Carnot and Rankine cycles, P-V and T-S diagrams. Determination of power output, cycle efficiency, work ratio and steam consumption. Total efficiency of steamship.
2. Marine boilers - Effect of boiler pressure, super heat, reheat and regenerative feed heating. Scotch boilers; internal and external examination procedures, tube removal and tube expansion, caulking, rivetting, welding.  
  
water tube boilers; internal and external examination procedure, tube removal and replacement, construction of plastic refractory combustion cone, maintenance of furnace lining. Repairing technic for emergency. Boiler cleaning, preservation and water treatment, boiler water testing. Pressure tests, accumulating test.  
  
Flash-up, steering and shutting down procedures. Precautions, emergency drills. Instrumentation, interpretation of data. Feed regulation, correct use of water gauge. Burner maintenance. Oil fuel burning systems. Gas, air, water and steam flow circuits in typical boilers. Tube sizes.
3. Steam turbine - Lubrication and control system, self-closing emergency valves, governors. Over-speed trips.  
  
Procedure for opening for examination; measurement of turbine clearances and rotor concentricity, identification of corrosion and erosion, adjustment of rotor position.  
  
Warming through, manoeuvring and shutting down. Lubrication system: causes of oil contamination, tests for water and salinity, clarification of lubricating oil.
4. Condensers - Application of Dalton's Law of Partial pressures to air/steam mixtures. Cleaning, examination and treatment. Steam side and water side pressure tests.
5. Feed System - Closed feed system; extraction pumps, de-aerators, regenerative heating, system modules. Control of system.
6. Evaporators - Process of distillation. Principles of construction; single and two-stage submerged coil, flash evaporators, mounting. Protection devices. Conditions for stable evaporation.
7. Condensate water system - Condensate water pump. Balancing pipe. Return pipe. U-tube for drain line.

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FINAL YEAR

3.506 NAVAL ARCHITECTURE

1. Ships construction. Review and application.

Forces acting on ships resulting in hogging, sagging, racking, panting and pounding. Arrangements, of anchors and cables. Ventilations and beating. Insulation of refrigerated ships. The survey of ships, general requirements and procedures.

2. Trim, Statical stability and stability curve.

Trim and change of trim due to adding. Removing or moving weights of small and large magnitude. Change in meandraft due to bilging amidship compartment. Change in drafts due to bilging and end compartment. (Calculations restricted to box barge forms).

Statical stability at large angles of heel. Cross curve and stability. Construction of stability curve from cross curves. Important features of stability curve. Stability information supplied to ships. Stabilisers treatment of types and effect.

3. Fire and life saving equipment

Fires and fire control systems. General fire fighting rules. Dangers of explosion of gas given off by coal and oil. Portable fire extinguisher. Automatic fire alarm system. Inert gas system. Pumping, flooding and draining, fresh water and sea water services. Regulations in respect of life saving appliances, boat and davits, crew spaces, water tight divisions. Construction and handling of life boat and life luft. Tanker construction and equipment on prevention of pollutions of the sea by oil. I.M.C.O.

4. Applied resistance and powering of ship

Components of resistance, calculation of frictional resistance ( $R_f$ ), wave making resistance ( $R_w$ ), eddy making resistance ( $R_e$ ). Total resistance. Estimate of residual resistance. Froude's law of comparison. Speed and power. Estimation of effective horse power. Admiralty coefficient. Fuel coefficient and fuel consumption. Problems on the prediction of full-scale resistance from model experiments. ITTC line.

5. Propeller and Propulsion

Definition of propeller terms. Construction and material of screw propeller. Controllable pitch propeller. Theory of screw propeller, thrust of propeller, relation between thrust, torque and efficiency. Presentation of propeller data. Cavitation, speed trail. Singing. Maintenance of propeller. Damage and method of repair of propeller. Stern bearing and stern tube. Calculation of slip.

6. Ship vibration

Causes, reduction and prevention of vibration. Whole Structure Natural Frequency. Influencing factors. Calculation using approximate formulae. Damping. Types of Damping.

FINAL YEAR

3.507 MARINE ENGINEERING PRACTICE AND LEGISLATION

1. MARINE ENGINEERING PRACTICE

1. General - Installation of main and auxiliary machinery, mounting, alignments, connections, controls. Care and maintenance of watertight doors, hatches, valves, etc. Use and management of compressed air system. Lifting appliances, wire ropes, cables and cordage, usage and maintenance. Safety handling of fuel and inflammable stores. Fire detection. Action and maintenance of fire-fighting equipment, extinguishers and breathing apparatus.
2. Shafting and propulsion - Shaft alignment techniques, taut wire, gap and sag. optical line, water trough. Parallel shafts. Inspection of main thrust block. Fitting and removal of propellers. Lubrication of propeller shaft. Cooling of shafting.
3. Trouble shooting on marine engines. Standard continuous running hours of marine engines.
4. Development of supervisory skills, Shipboard relations, leadership and teamwork.
5. Marine insurance. Safety and accident prevention. Education, training and welfare of seafarers.

11. LEGISLATION

1. Malaysian Merchant Shipping Ordinance (1952).
2. Merchant Shipping Notices.
3. Manning requirements.

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FINAL YEAR

3.508 CONTROL ENGINEERING

1. Actuators - Description of the basic elements and construction of a control valve, including packing and lubrications.

Types of valve trim, plugs, single and double seat control valves. Direct and reverse action. Use of air fin bonnets and multi port valves. Butterfly valves. Diaphragm valve. Piston valve.

2. Controller (Regulator) - Procedure and adjustment of pneumatic controllers, electrical controllers, pneumatic electrical controllers, valve positioners, pilot valves, self operating controllers, pressure balance valves.

3. Actual automatic Control - Examples of single. Two and three elements feed water controls, steam pressure and temperature controls, fuel/air ratio control, cascade control, viscosity control of fuel oil. Measurement of  $CO_2$ ,  $O_2$  and viscosity.

Example of exhaust range pressure control, gland steam pressure control, soot blower control, condenser circulating water temperature control, steam temperature control, automatic combustion control.

Warming and finish engine sequential control, auto spinning system.

Jacket and piston cooling water temperature control. Smoke and fire detections, flame failure monitors. Scavenging fire detectors. Oil mist detectors. Bridge control system. Telegram recorders. Monitoring and scanning systems. Date logger. Use of mimic diagrams with alarm annunciators. Use of integrators and digital voltmeters for read out.

Maintenance and repair of control equipments. Testing of control equipments.

Salinometer - Crockatt Simplex Patent Electric Salinometer.

4. Concept of Automatic Control - the closed loop idea - open loop system. Examples of transition from manual to automatic. Two-position control - application. Proportional control. Floating mode of control - single speed, proportional speed, multi-speed. Step - linear - sinusoidal change.

Rate mode of control.

Controller Combinations.

Examples on pneumatic, Hydraulic, electric and Electronic circuits and their applications.

Controlled System Analysis.

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FINAL YEAR

3.509 I. APPLIED ELECTRONICS & ELECTROTECHNOLOGY

1. Applied Electronics - Revision, basic electronic valves and application, semiconductor devices, identification relative to B.S.I. symbols.
2. Power supply - transformer, step up, step down, rectification and operation, halfwave and full wave, types of filter, capacitor input, choke input, regulator, using zener, using transistor, inverter circuit.
3. Amplifier - types of transistor amplifier, operation, bias arrangement and stabilization, A.C. and D.C. load line, frequency range, noise filter, interstage coupling, multistage amplifier, h-parameter equivalent circuit.
4. Oscillator - types, astable, monostable, bistable oscillator, integrator circuit, differentiator circuit, IC oscillator, application.
5. Electronic Control & Protection - Overload protection circuit, control circuit, temperature, water level, alarm annunciator equipment, operation, logic circuit, relay logic, electronic logic, application of Boolean Algebra.
6. Fault Finding and Maintenance - Circuit tracing, redraw and recognition of circuit, method of checking faulty component, use and interpretation of operation manuals.
7. Material and components - screen cable, multi core cable, plug and socket connections, duty rating, reliability, other devices - field effect transistor, unijunction transistor, photo transistor, light emitting diode thyristor.
8. Telecommunication - Introduction, block diagram of transmitter and receiver for AM and FM type. Operating Band. Operation. Interference and Noise.

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FINAL YEAR

3.509 II. MARINE ELECTRO TECHNOLOGY

1. D.C. generators - Control and operating techniques. Comparison of characteristics with particular. Parallel operation, load sharing, equalizer connection. Regulation with particular reference to instrumentation.
2. A.C. generators - Brief comparison of salient, non-salient and brushless alternators with particular reference to applications. Simple phase phasor diagrams, load characteristic, voltage regulation. Waveform improvement. Estimation of synchronous impedance. Short circuit condition. Parallel operation of A.C. generators; Load sharing, synchronising techniques (manual and automatic), lamps dark and methods, phase rotation tests and the synchroscope.
3. Automatic voltage regulations - Requirements, Regulations statio permitted voltage limits - refer to response. Basic-design; Detector, corrector and stabilising elements. Outline of suitable types with detailed consideration of say two e.g. carbon pile, electronic, magnetic amplifier.
4. A.C. motors - Commutator machines, linear motors. Starting and control equipment for A.C. motor; Pole changing.
5. Distribution system - Permitted system (I.E.E. and LYOD's regulation); Factors affecting choice of system. Emergency supplied; Reference to self contained and integral A.C. and D.C. systems. Protection; Preferential tripping, switches, isolators, contactors, current and power relays. Short circuit protection. Isolators with particular reference to earthing of high voltage equipment/system for safety.
6. Transformers - the auto-transformer; General considerations of advantages/disadvantages for marine application e.g. in motor starter and instrumentation. Instrument transformers, applications. Burden, class, terminal markings.
7. Steering gear system - General requirement of the electrical plant. Types; Electro-hydraulic, Ward-Leonard and follow up systems. Alarm circuits.
8. Batteries - Application of primary and secondary cells for ship-board use. Battery charging arrangement. Comparison of type. Safety. Maintenance.
9. Electrical propulsion systems - General requirement of the electrical system. Suitability of electrical system. Suitability of electrical system for classes of ship. Outline of constant current and constant voltage D.C. and of polyphase A.C. systems. Earthing, voltage distribution diagrams.
10. Lighting systems and illumination - B.O.T. requirements for illumination. Measurement of level of illumination. Types of lamps and applications, advantages and disadvantages. Fluorescent lamp circuits.
11. Circuit theory - Further development of general circuit theory; Bridge circuits e.g. gas detectors, strain gauge, temperature gauge.

12. Rectifiers and inverters - Basic type and applications for power; supplies. Three phase units. Controlled rectifications. Basic principles of motor speed control using solid state controls e.g. thyristors.

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FINAL YEAR

3.510 MATERIALS TECHNOLOGY

1. Non-ferrous Metal - Copper alloy, Brass, Bronze, White metal. Kelmet. Trimetal bearing. Aluminium alloy. Magnesium alloy. Nickel, Cobalt alloy. Titanium and Zirconium alloy. Zinc, Lead, tin and those alloy.
2. Sintered Metal - Manufacturing system of sintered metal. Property of sintered metal.
3. Plastic - Thermosetting plastic. Heat hardenability plastic. Strengthening plastic.
4. Protection of corrosion.
5. Properties of metals and testing techniques - Tensile stress, compressive stress, shearing stress, hardness, toughness, brittleness, wear, fatigue.
6. Defects of steel block - Blow hole, segregation, ghost line.
7. Surface hardening - Flame hardening, high frequency hardening, shot peening, carbonizing, nitriding, cyanide process, chrome plating (porous chrome plating).

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FINAL YEAR

3.511 AUXILIARY MACHINERY

1. Ship general - Bilge and ballast system. Fuel oil filling and transfer system. Fire pump and emergency use. Power-operated water-tight doors. Mechanical aspects of turbo and diesel generators and alternators.
2. Steering gear - Methods of connection of rudder. Telemotors system. Routine servicing of Hele Shaw pump.
3. Evaporators - types of evaporators and constructions. Working principles - advantages and disadvantages. Air-ejectors.
4. Pumps - theory and calculations of reciprocating and centrifugal pumps. Valves and Fittings.
5. Purifier - Cravitation separation. Clarification and separation - Disc and Bowl centrifuges. Sharples. De-lawal, self-cleaning.
6. Refrigeration. Basic principles - phase changes. Refrigerants - properties. Vapour compression system - operating cycle, calculations. Air-conditioning - basic principles, circuit, heat pump, Dehumidifier, Cooling water tower.
7. Condensers and De-aerators. Basic principles and constructions.

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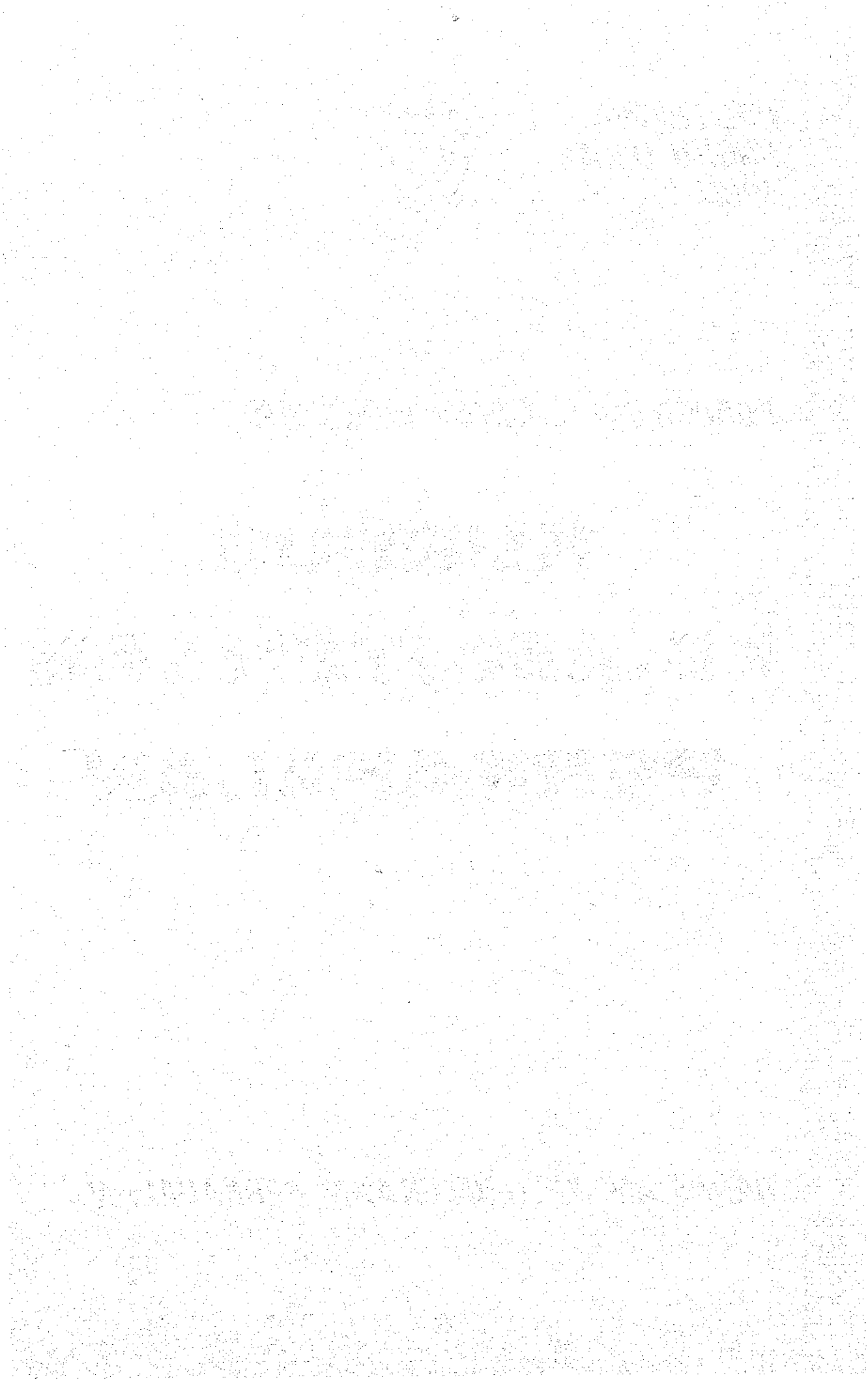
**POLITEKNIK  
UNGKU OMAR,  
IPOH.**



**KURIKULUM LATIHAN WOKSYOP**

**KURSUS  
KEJURUTERAAN  
PERKAPALAN**

**BAHAGIAN KEJURUTERAAN PERKAPALAN**



MARINE WORKSHOP PRACTICE (MM-II)

<u>Item</u>	<u>Subject</u>	<u>Details and Remarks</u>
II-1-1	Single stage volute pump (B-2-2-1)	1) To make planning and practical methods to overhaul, to check, to measure and to remount a single stage volute pump. 2) Free-hand drawing for the purpose to order spare parts. (Study and practice).
II-1-2	Gear pump (B-2-2-2)	1) To make planning and practice methods to overhaul, to check, to measure and to remount a gear pump. 2) Free-hand drawing for the purpose to order spare parts. (Study and practice).
II-1-3	Worthington pump (1) (A-4-1-1)	1) Observation of constructional design for making plans to overhaul, to remount and to operate a worthington pump. 2) Overhauling the pump. (Study and practice).
II-1-4	Worthington pump (2) (A-4-1-2)	1) Recording the result of measurement of working parts. 2) Free-hand drawing for the purpose to order spare parts. 3) Remounting and adjusting practices. 4) Operation and confirmation of good working conditions. (Practice).
II-1-5	Viscosity (B-2-1-1)	1) Recognition of the device. 2) To make a plan to take measures of viscosity. 3) Safety keeping preparation. 4) Measurement of viscosities of both fuel and lubricating oils. 5) Analysis of the above result for an actual purifier. (Study and Practice).

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- II-1-6 Igniting point (B-2-1-2) 1) Recognition of the device.  
 2) To make a plan to take measures of igniting point.  
 3) Safety keeping preparation.  
 4) Measurement of igniting points of both fuel and lubricating oils.  
 5) Analysis of the above result for an appliance.  
 (Study and practice).
- II-1-7 Purifier (B-1-4-1) 1) Observation for constructional design and piping arrangement.  
 2) Comparison of the system with that in an actual merchant ship.  
 3) Proper methods of both operation and maintenance works.  
 4) To make a plan to overhaul and to remount the device.  
 (Study).
- II-1-8 Purifier (B-1-4-2) 1) Operation and maintenance works.  
 2) Dismantling and cleaning works.  
 3) Changing method of discharge screw.  
 4) Remounting work.  
 5) Proper trail technique.  
 (Practice).
- II-1-9 Steering gear (B-1-3-1) 1) Inspection for constructional design.  
 2) Comparison of the system with that of the other types in actual ships.  
 3) Planning both trial and maintenance manual.  
 4) Operation and maintenance works.  
 5) Warning and alarming system in an actual ship.  
 (Study and Practice).

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- II-1-10 General work  
(A-all,  
B-all)
- 1) Leakage test on piping lines.
  - 2) Lubrication for idle engines.
  - 3) Cleaning-up works.
  - 4) Checking works of spare parts and tools.
  - 5) Miscellaneous works (touching-up paints, small repair work). (practice).
- II-2-1 Pressure Gauge  
(B-2-1-3)
- 1) Adjusting technique of pressure gauge.
  - 2) Investigation of constructional kinds of pressure gauges.
  - 3) Relation between location of pressure gauge and indication of it.
  - 4) Investigation of pressure convertor.
  - 5) Investigation of pressure-control system. (Study and Practice),
- II-2-2 Servomechanism  
(B-2-1-4)
- 1) Investigations of effects on individual elements of servomechanism.
  - 2) Inspection of constructional mechanism.
  - 3) Checking method of each device.
  - 4) Investigation of many kinds on servomechanism. (Study and Practice).
- II-2-3 Refrigerator  
(B-1-5-1)
- 1) Observation of constructional design and piping arrangement.
  - 2) Planning the proper procedures for for actual operation and for maintenance work.
  - 3) Programming the method to get necessary data for measurement of thermal efficiency and capacity. (Study).

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- II-2-4 Refrigerator  
(B-1-5-2)
- 1) Operation and maintenance practice on the refrigerating system.
  - 2) Practical work for charging refrigerant.
  - 3) Practical work for rebottling refrigerant.
  - 4) Practical work for purging air.
  - 5) Practical work for supplying of lubricating oil.
  - 6) Technical check of gas-leakage. (Practice).
- II-2-5 Refrigerator  
(B-1-5-3)
- 1) Operation for efficiency and capacity examination.
  - 2) Practical work on defroster.
  - 3) Analysis of the above-mentioned result to make performance diagram and heat balance diagram. (Practice and Study).
- II-2-6 Boiler  
(A-4-1)
- 1) Observation of constructional design and piping arrangement.
  - 2) Proper procedures of extracting boiler water, of testing it, of supplying boiler compounds and of blowing boiler water.
  - 3) Actual calculation method to keep boiler water in good density of elemental matters. (Study and Practice).
- II-2-7 Diesel generator 4 stroke cycle engine  
(A-2-1-1)
- 1) Observation of construction design and piping arrangement.
  - 2) Inspection for operating device of water rheostat.
  - 3) Investigation of the rules about marine dynamo-engine. (Study).

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- II-2-8 Diesel generator - main switch board & A.C. generator (A-2-2-1)
- 1) Observation and investigation of constructional design.
  - 2) Investigation of types of them in actual merchant ships.
  - 3) Investigation of automatic operation devices. (Study).
- II-2-9 Fresh water generator (A-2-3-1)
- 1) Observation and investigation of constructional design.
  - 2) Investigation of types of them in actual merchant ships.
  - 3) To make plans to operate the system, to maintain it and overhaul it. (Study).
- II-2-10 General work (A-all, B-all)
- 1) Leakage test on piping lines.
  - 2) Lubrication for idle engines.
  - 3) Cleaning-up works.
  - 4) Checking works of spare parts and tools.
  - 5) Miscellaneous works (touching-up paints, small repair work). (Practice).
- II-3-1 Diesel generator - 4 stroke cycle engine, main switch board & fresh water generator. (A-2-1,2,3-2).
- 1) To make plans of operation and maintenance for dynamo engine and fresh water generator.
  - 2) To make actual technical manual for operation of main switch board - parallel running technic.
  - 3) To make measurement method for performance test. (Study).
- II-3-2 Diesel generator - 4 stroke cycle engine, main switch board & fresh water generator. (A-2-1,2,3-3).
- 1) Starting and stopping technique of 4 stroke cycle engine.
  - 2) Practice to take indicator diagram.
  - 3) Practice to operate main switch board for parallel running with handling water rheostat.

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- 4) Measuring data necessary for performance test.
  - 5) To make heat-balance diagram and to obtain thermal efficiency.  
(Practice and Study).
- II-3-3 Diesel generator -  
4 stroke cycle engine  
(A-2-1-4)
- 1) General checking method.
  - 2) Practice how to examine fuel-injection pump and valve.
  - 3) Practical measuring method of crankarm deflection.
  - 4) Practical measuring method of oil clearances on crank and journal bearings.
  - 5) Analysis of data measured.  
(Practice and Study).
- II-3-3 Diesel generator -  
4 stroke cycle engine  
(A-2-1-4)
- 1) General checking method.
  - 2) Practice how to examine fuel-injection pump and valve.
  - 3) Practical measuring method of crankarm deflection.
  - 4) Practical measuring method of oil clearances on crank and journal bearings.
  - 5) Analysis of data measured.  
(Practice and Study).
- II-3-4 Diesel generator -  
4 stroke cycle engine  
(A-2-1-5)
- 1) Practical check of respective valve-timings.
  - 2) Adjusting method for tappet clearance (valve lever of clearance).
  - 3) Practical measurement of 0-injection point.
  - 4) Inspection work on gear case and governor.  
(Practice).

- II-3-5 Diesel generator -  
4 stroke cycle engine  
(A-2-1-6)
- 1) To make a plan of proper order for overhaul and remounting.
  - 2) To make recording paper for measurement of working part.
  - 3) Preparation work to provide tools and special gauge.
  - 4) Study for getting accurate data on measuring working part.  
(Study and practice).
- II-3-6 Diesel generator -  
II-3-7 4 stroke cycle engine  
(A-2-1-7)  
(A-2-1-8)
- 1) Practice to pull piston out with checking work.
  - 2) Cleaning technique drill for vital working parts.
  - 3) Measuring and checking practice on vital necessary working part.
  - 4) Remounting work in proper good order.
  - 5) Checking method before trial after overhauling.
  - 6) Trial practice.
  - 7) Analysis of result of measured data.  
(Practice).
- II-3-8-1 Diesel generator-  
main switch board.  
(A-2-2-4)
- 1) Checking work for maintenance.
  - 2) Safety keeping preparation.  
(Practice).
- II-3-8-2 Boiler  
(A-4-2-1)
- 1) Observation of constructional design and equipments fitted on the surface directly.
  - 2) Entering combustion chamber for observation.
  - 3) Operation drill of the simulator panel.  
(Practice and Study).

II-3-9 Air compressor  
(A-1-1)

- 1) Observation of constructional design.
- 2) To make a plan to operate and to maintain it.
- 3) Checking method for maintenance.
- 4) Operation drill for charging air.
- 5) Overhauling and sketching suction and delivery valve.  
(Practice and Study).

II-3-10 General work  
(A-all, B-all)

- 1) Leakage test on piping lines.
- 2) Lubrication for idle engines.
- 3) Cleaning-up work.
- 4) Checking works of spare parts and tools.
- 5) Miscellaneous works (touching-up paint, small repair work).  
(Practice).

MARINE WORKSHOP PRACTICE (MN-IV)

<u>Item</u>	<u>Subject</u>	<u>Details &amp; Remarks</u>
III-1-1 (III-1-2)	Boiler (A-4-1-1)	1) Observation of constructional design and pipe arrangement. 2) Investigation of control circuits and their devices. 3) Inspection of safety keeping devices and their working points. 4) Observation of locations for measuring points. (Study).
III-1-2 (III-1-1)	Steam turbine (A-3-1-1)	1) Observation of constructional design and pipe arrangement. 2) Investigation of manoeuvring devices and interlocking safety system and their working points. 3) Observation of location for measuring point. (Study).
III-1-3 (III-1-4)	Boiler (A-4-1-2)	1) Observation of working circuit and construction of simulator. 2) Operation drill of simulator. 3) To make a plan of proper operation and inspection manuals. (Practice and Study).
III-1-4 (III-1-3)	Steam turbine (A-3-1-2)	1) Observation of constructional design and working mechanism of steam ejector and hydro-dynamometer. 2) To make a plan of proper operation and overhauling manuals. - warming up, trial, operation cooling down, injection etc. (Study).
III-1-5 (III-1-6)	Boiler (A-4-1-3)	1) Operation practice of boiler and Worthington pump. 2) Calculation of boiler efficiency. 3) Drill of blowing boiler water off.

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- 4) Drill of obtaining sample of boiler water for density examination.
  - 5) Drill of supplying boiler compound. (Practice and Study).
- III-1-6      Steam turbine  
(III-1-5)    (A-3-1-3)
- 1) Warming-up engine practice with making expansion diagram.
  - 2) Handling and checking drill on the trail process.
  - 3) Operation and maintenance with measuring necessary data for obtaining mechanical efficiency and heat balance diagram.
  - 4) Cooling-down practice. (Practice and Study).
- III-1-7      Boiler  
(III-1-8)    (A-4-1-4)
- 1) Inspection practice of both water and fire sides.
  - 2) Cleaning and repair drills of both water and fire sides.
  - 3) Overhauling, checking and remounting practice on working pump. (Practice).
- III-1-8      Steam turbine  
(III-1-7)    (A-3-1-4)
- 1) Overhauling and inspecting practice.
  - 2) Practice for wear-down and thrust-pad clearance measurement.
  - 3) Remounting practice. (Practice).
- III-1-9      A.C. motor cargo winch & Electro hydraulic cargo winch  
(B-1-2-1,2)
- 1) Observation of constructional designs and mechanisms.
  - 2) Investigation of speed control circuit and system.
  - 3) Operation practice.
  - 4) Trouble shooting. (Study and Practice).

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| III-1-10    General work<br>(A-all, B-all)  | 1) Leakage test on piping lines.<br>2) Lubrication for idle engines.<br>3) Cleaning-up work.<br>4) Checking work of spare parts<br>and tools.<br>5) Insulation test of main circuit<br>and control circuit.<br>6) Miscellaneous works (touching-up<br>paint, small repair work).<br>(Practice).             |
| III-2-1     Diesel genera-<br>tor & Fresh<br>water generator<br>(A-2-1,2).        | 1) Observation of constructional<br>designs and mechanisms.<br>2) Operation and maintenance prac-<br>tices - start and stop, parallel<br>running, alternator changing<br>technique, combustion checking<br>technique, efficient operation<br>of fresh water generator etc.<br>(Study and Practice).         |
| III-2-2     2-stroke cycle<br>diesel engine-<br>engine and<br>piping<br>(A-1-1).  | 1) Observation of constructional<br>designs and mechanisms.<br>2) Observation and designing piping<br>arrangement comparing with actual<br>merchant ship.<br>(Practice and Study).  |
| III-2-3     2-stroke cycle<br>diesel engine-<br>engine and<br>circuit.<br>(A-1-2) | 1) Investigation of control circuit.<br>2) Observation of location of<br>measuring point, interlocking<br>safety devices and their normal<br>working condition.<br>3) To make a plan to operate engine<br>in proper order - warming-up, trial<br>operation (maintenance) and cooling-<br>down).<br>(Study). |

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- III-2-4 2-stroke cycle diesel engine-  
engines and hydraulic dynamometer.  
(A-1-3).
- 1) Observation of constructional design and mechanism of hydraulic dynamometer.
  - 2) To make a plan to obtain mechanical efficiency and heat balance diagram.
  - 3) To make a plan of general checking points followed operation.
  - 4) Preparation work for actual operation.  
(Study and Practice).
- III-2-5 2-stroke cycle diesel engine-whole system  
(A-1-4).
- 1) Warming-up practice.
  - 2) Drill of trial technique.
  - 3) Start-and-stop exercise.
  - 4) Operation and maintenance practices.
  - 5) Taking practice of indicator diagram.
  - 6) Measurement to obtain necessary data for mechanical efficiency and heat balance diagram.
  - 7) Cooling-down practice.
  - 8) General checking practice.  
(Practice).
- III-2-6 2-stroke cycle diesel engine-engine.  
(A-1-5).
- 1) Practice of measuring technique of crank-arm deflection.
  - 2) Practice of measuring technique of oil-clearance on both crank-pin and journal bearings.
  - 3) Analysis of the result obtained by the above practice.  
(Practice and Study).
- III-2-7 2-stroke cycle diesel engine-engine.  
(A-1-6).
- 1) Inspection and examination of both fuel injection pump and valve.
  - 2) Maintenance practice of both fuel injection pump and valve.
  - 3) Practice how to obtain C-injection point.
  - 4) Measurement valve-timings and drawing their diagram.  
(Practice and Study).

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- |          |   |   |
|----------|---|---|
| III-2-8  | 2-stroke cycle diesel engine-control circuit (A-1-7). | <ol style="list-style-type: none"> <li>1) Practice to check control circuit.</li> <li>2) Study and sample of actual remote control circuit. (Practice and Study).</li> </ol>  |
| III-2-9  | 2-stroke cycle diesel engine - supercharger (A-1-8)   | <ol style="list-style-type: none"> <li>1) Observation of constructinal design and mechanism.</li> <li>2) Opening, cleaning, checking and remounting practice. (Study and Practice).</li> </ol>  |
| III-2-10 | General Work (A-all, B-all)                           | <ol style="list-style-type: none"> <li>1) Leakage test on piping lines.</li> <li>2) Lubrication for idle engines.</li> <li>3) Cleaning-up work.</li> <li>4) Checking work of spare parts and tools.</li> <li>5) Insulation test of main circuit and control circuit.</li> <li>6) Miscellaneous works (touching-up paint, small repair work). (Practice).</li> </ol>   |
| III-3-1  | 2-stroke cycle diesel engine - engine. (A-1-9).       | <ol style="list-style-type: none"> <li>1) To make a plan to overhaul and to remount engine in good proper order.</li> <li>2) To make recording paper to measure data necessary and proper measuring methol - piston top clearance, piston ring, piston ring groove, wear-down of piston crown, piston diameter, cylin der bore, gudgeon pin (hardness, diameter, oil clearance), crank pin (diameter, oil clearance), journal (wear down, oil clearance), checking gears. (Study).</li> </ol> |
| III-3-2  | 2-stroke cycle  | 1) Overhauling practice.  |
| III-3-3- | diesel engine -                                       | 2) Measuring practice.  |
| III-3-4  | engine (A-1-10,11,12)                                 | <ol style="list-style-type: none"> <li>3) Checking Practice.</li> <li>4) Adjusting and fitting practice.</li> <li>5) Remounting practice.</li> </ol>  |

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- 6) Final adjusting and checking practice.
  - 7) Lubrication and water-running practice.
  - 8) Later adjusting practice.
  - 9) Trial practice after overhaul.
  - 10) Analysis of the result recorded by measurement.  
(Practice and Study).
- III-3-5 Multiple-staged valute pump  
(B-2-2-1)
- 1) To make planning and practical methods to overhaul, to check, to measure and to remount a multiple - staged valute pump.
  - 2) Free-hand drawing for the purpose to order spare parts.  
(Study and Practice).
- III-3-6 Electric motor starter  
(B-1-1-1)
- 1) To make actual drawing of electric motor starters.
  - 2) Trouble shooting of the starters.
  - 3) Practice to repair elements for the starters.  
(Study and Practice).
- III-3-7 Refrigerator  
(B-5-1)
- 1) Practice to operate refrigerator.
  - 2) Adjusting practice of manual expansion valve.
  - 3) Practice how to supply lubricating oil and refrigerant.
  - 4) Practice how to recharge refrigerant to gas-cylinder.
  - 5) Practice how to maintain automatic expansion valva.
  - 6) Practice how to separate and purge air from refrigerant.
  - 7) Practice how to check gas-leakage.
  - 8) Practice how to defrost in evaporator.

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- 9) Practice how to check proper quantity of refrigerant.
- 10) Practice how to check efficient working condition.  
(Practice).

III-3-8 2-stroke cycle  
diesel engine  
(A-1-13)  
(A-2-3)

Case study for emergency.

- 1) Countermeasure to black out.
- 2) Countermeasure to sudden stop.
- 3) Countermeasure to double astern.
- 4) Countermeasure to breakdown of supercharger.
- 5) Countermeasure to breakdown of cylinder cover.
- 6) Countermeasure to breakdown of piston.
- 7) Countermeasure to use diesel engine for air compressor.
- 8) Countermeasure to operation in stormy sea.
- 9) Countermeasure to flood.
- 10) Countermeasure to fire.  
(Practice and Study).

III-3-9 Steam turbine  
(A-3-1-5)  
(A-4-1-5)

Case study for emergency.

- 1) Countermeasure to leakage of water tube.
- 2) Countermeasure to out of order on one of the boilers.
- 3) Countermeasure to out of order on low pressure cylinder of steam turbine.
- 4) Countermeasure to out of order on high pressure cylinder of steam turbine.
- 5) Countermeasure to stormy sea.
- 6) Countermeasure to shortage of fuel oil.
- 7) Countermeasure to flood.
- 8) Countermeasure to fire.

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- 9) Countermeasure to steam leakage.
- 10) Countermeasure to black-out.
- 11) Countermeasure to sudden stop order.
- 12) Countermeasure to double astern.

III-3-10 General work  
(A-all, B-all)

- 1) Leakage test on piping lines.
- 2) Lubrication for idle engines.
- 3) Cleaning-up work.
- 4) Checking work of spare parts and tools.
- 5) Insulation test of main circuit and control circuit.
- 6) Miscellaneous works (touching-up paint, small repair work).  
(Practice).

ELECTRIC & ELECTRONIC PRACTICE

<u>Item</u>	<u>Subject</u>	<u>Details &amp; Remarks</u>
II-1	Multiple tester (B-2-2)	<ol style="list-style-type: none"><li>1) To recognize constructional design and mechanism.</li><li>2) Practice how to measure resistant valve.</li><li>3) Practice how to check capacitor.</li><li>4) Practice how to measure voltage on both A.C and D.C and the reason why the A.C range is employed individually from D.C range.</li><li>5) Practice how to measure small D.C current.</li><li>6) Practice to shoot melted fuse out.</li><li>7) Practice to check actual circuit on starters of electric motor.</li><li>8) Practice how to check commutator.</li></ol>
II-2	Resistance tester (B-2-2)	<ol style="list-style-type: none"><li>1) To recognize constructional design and mechanism.</li><li>2) Main points to handle the resistance tester.</li><li>3) Practice how to measure the value of insulation.</li><li>4) Practice how to shoot earthing point.</li><li>5) To understand different recording methods by 500 V meg-ohm and by 1000 V meg-ohm.</li><li>6) Matters to be checked under the law.</li><li>7) Method to increase insulated resistance of electric generator and motor.</li></ol>
II-3	Starter of electric motor (B-1-1)	<ol style="list-style-type: none"><li>1) Study how to read down electric circuit.</li><li>2) Comparison of circuit elements with actual starters.</li><li>3) To recognize the constructional design and mechanism of essential elements.</li></ol>

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- 4) To make actual electric circuit diagrams comparing with skeleton diagrams.
  - 5) Trouble shooting.
- II-4      Ward Leonard system  
(B-1-1)
- 1) Investigation how to control speed of A.C and D.C electric motors.
  - 2) Observation of electric circuit of Ward Leonard system.
  - 3) To make actual electric circuit-diagram comparing with skeleton diagram.
  - 4) Practice to get performance test record.
- III-1      TRS pulse circuits  
experimental  
equipment  
(B-2-2)
- 1) To recognize the constructional design and mechanism of oscilloscope.
  - 2) Experiments.
    - i) Rectifier and filter circuit.
    - ii) D.C voltage regulator circuit.
    - iii) Waveform conversion circuit.
    - iv) The astable multi-vibrator.
    - v) The monostable multi-vibrator.
    - vi) The bistable multi-vibrator.
    - vii) Counter circuit.
    - viii) Schmidt trigger circuit.
    - ix) Clamp circuit.
    - x) Logic circuit.
  - 3) Schematic diagram.
    - i) Power supply circuit.
    - ii) Waveform conversion circuit.
    - iii) Multi-vibrator circuit (astable and bistable).
    - iv) Multi-vibrator circuit (Monostable)
    - v) Schmidt and clamp circuit.
    - vi) Logic circuit.

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HYDRODYNAMICS EXPERIMENTAL EQUIPMENT

1-1 Hydraulic experi-  
mental equipment  
(B-1-5)

Experiment.

- 1) To make load-quantity  
diagram of cavitation  
pump and 3-stage turbine  
pump.



## (13) LIST OF TEXTBOOKS &amp; OTHER TEACHING MATERIALS

No.	Author	Title	Publisher
<u>1. MATHEMATICS</u>			
1	Embleton	Mathematics for Marine Engineers.	Reed's series.
2		Mathematics.	JICA.
3		R & F Practical Mathematics. 2nd Class Part 1 - Mathematics (in SI UNITS).	James Munro & Co., Ltd.
4		R & F Practical Mathematics 2nd Class Part 2 - Applied Mechanics.	
<u>2. PHYSICS &amp; CHEMISTRY</u>			
1	Schofield	Physics for O.N.C. Engineers	McGraw-Hill Maiden head.
2	Barritt, K.D.	Elective Physics for the Ordinary National Certificates & Diploma in Science.	Macmillan.
3		Chemicals in Ships.	Institute of Marine Engineers.
4		Corrosion for Marine and Offshore Engineers (Part II).	"
5		Storage Handling of Petroleum Liquids.	James Munro & Co., Ltd.
<u>3. THERMODYNAMICS &amp; GENERAL ENGINEERING SCIENCE</u>			
1	Titherington	Heat and Heat Engines for Marine Engineers (Vol. 3).	Reed's series.
2		Mechanical Engineering Science	McGraw-Hill Maiden head.
3		Strength of Materials	Macmillan.
4		Strength Materials: Theory and Examples	Arnold.
5		Lewritt, E.H.	Hydraulic and Fluid Mechanics.

No.	Author	Title	Publisher
6	Herbert Addison	A Treatise on Applied Hydraulics.	Chapman.
7	P.D. Collins and A. Jackson	Applied Mechanics for O2.	Longman.
8		Marine Meteorology.	JICA.
9		Science.	"
10		Selecting Materials for Sea Water System (Part 10).	Institute of Marine Engineers.
11		Marine Steam Turbines.	"
12		Basic Engineering Thermodynamics (Joel)	Longman Group.
<u>4. ELECTRICITY &amp; ELECTRONICS</u>			
1	E.G.R. Kraal	Electro Technology for Marine Engineers (Vol. 6).	Reed's series.
2	"	Advance Electro Technology for Marine Engineers (Vol. 7).	"
3	Scull	Ship Wiring.	"
4	Theraja, B.L.	Electrical Technology.	S. Chand & Co.
5		Electricity I.	JICA.
6		Electricity II.	"
7		Prime Movers for Generation of Electricity (Part 2) a) Steam Turbines b) Medium Speed Diesel Gen Sets.	Institute of Marine Engineers.
8		Electricity Applied to Marine Engineering.	Institute of Marine Engineers.
9	Watson	Marine Electrical Practice	Butterworths.

No.	Author	Title	Publisher
<u>5. MARINE ENGINEERING-BOILERS, TURBINES &amp; AUXILIARIES</u>			
1	L. Jackson & T.D. Morton	Steam Engineering Knowledge for Marine Engineers (Vol. 9).	Reed's series.
2	Fox W.J.	Marine Auxiliary Machinery.	James Munro.
3	Paterson W.S.	Marine Power Plant Guide.	Cornell Maritime.
4		Selection, Installation and Maintenance of Marine Compressors (Part 1).	Institute of Marine Engineers.
5		Hydraulic Power Transmission in Marine Machinery (Part 7).	"
6		Marine Steam Turbines (Part 8).	"
7		Steering Gear (Part 9).	"
8		Commissioning and Sea Trials of Machinery in Ships (Part 12).	"
9		The Theory and Practice of Controllable Pitch Propellers (Part 13).	"
10		Water Treatment (Part 14).	"
11		Operation of Machinery in Ships: Steam Turbine, Boilers & Aux Plant (Pt 15).	"
12		Ship's Gear: A Review of Deck Machinery (Part 16).	"
13		Operation of Machinery in Motor- ships: Main Diesels, Boilers & Aux Plant (Pt 18).	"
14		Factors in the Selection of Marine Machinery and Plant, with Particular Reference to Reliability, Maintenance and Cost.	"
15		Marine Gearing.	"
16		Marine Boiler Survey Handbook.	"
17		Marine Steam Turbines.	"
18		Pumping System.	"

No.	Author	Title	Publisher
19		Running and Maintenance for Marine Machinery.	Institute of Marine Engineers.
20		Steam Propulsion for Ships in the Changing Economic Environment.	"
21	Souchotte & Smith	Marine Auxiliary Machinery	Butterworth.
22	Crawford	Marine and Offshore Pumping and Piping System.	"
23		Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands.	Witherby & Co., Ltd.
<u>6. MARINE ENGINEERING - DIESEL ENGINES &amp; ENGINEERING KNOWLEDGE</u>			
1	Lamb	The Running and Maintenance of Marine Diesel Engines.	Griffin.
2	Paterson, W.S.	Marine Engine Room Blue Book.	Cornell Maritime.
3	Paterson, W.B.	Red Book of Marine Engineering Question & Answers, Vol. 1.	"
4	Paterson, W.B.	Red Book of Marine Engineering Question & Answers, Vol. 2.	"
5		Marine Engines I.	JICA.
6		Marine Engines II.	"
7		Marine Engines III.	"
8		Operation I.	"
9		Operation II.	"
10		Operation III.	"
11		Operation IV.	"
12		Marine Medium Speed Diesel Engines (Pt 3).	Institute of Marine Engineers.
13		Slow Speed Diesel Engines.	"
14		Medium and High Speed Diesel Engines for Marine Use.	"
15	Pounder	Marine Diesel Engines.	Butterworth.
16	Taylor	Introduction to Marine Engineering.	"

No.	Author	Title	Publisher
17		Southern's Marine Diesel Oil Engines.	James Munro & Co., Ltd.
18	Watson & Janota	Turbocharging and Internal Comb. Engines.	Macmillan.
19	Christen Knak	Diesel Motor Ships Engine & Machinery: Text & Drawing.	GEC Gad.
<u>7. REFRIGERATION AND AIR CONDITIONING</u>			
1	Richard, P.	Marine Air Conditioning & Refrigeration.	Cornell Maritime.
2		Refrigerating Machinery and Air Conditioning Plant (Part 4).	Institute of Marine Engineers.
3	Meredith	Refrigeration Technition's Pocket Book.	Butterworth.
4	Munton & Stott	Refrigeration at Sea.	Applied Science.
<u>8. ENGINEERING DRAWING &amp; MACHINE DESIGN</u>			
1	Barr, H.	Practical Drawing Book for Marine Engineers MacGibbon's Pictorial Drawing Book for Marine Engineers.	Jame Munro.
2	Parkinson	First Year Engineering Drawing.	Pitman.
3		Machine Works.	JICA.
4	F. Pick Up & M.A. Parker	Engineering Drawing with Worked Example - Vol. 2.	Hutchinson.
5	"	Engineering Drawing with Worked Example - Vol. 1.	Edward Arnold L.
<u>9. MARINE ENGINEERING INSTRUMENTATION &amp; CONTROL SYSTEM</u>			
1		Automatic Control.	JICA.
2		Application of Automatic Machinery and Alarm Equipment in Ships (Part 6).	Institute of Marine Engineers.

NO.	Author	Title	Publisher
<u>10. MARINE ENGINEERING WORKSHOP &amp; REPAIR TECHNOLOGY</u>			
1	Chapman, W.A.J.	Workshop Technology Part 1.	Arnold.
2	"	" " Part 2.	"
3	Pritchard, R.T.	Workshop Technology for Mechanical Engineering Technicians Part 3.	English VP
4	"	Workshop Technology for Mechanical Engineering Technicians Part 4.	"
5	Godwin, W.W.	Marine Pipe Covering.	Cornell Maritime.
6	Gochring, E.P.	Marine Piping Handbook.	"
7		Marine Services on Boardship	JICA.
8	AE Darbyshire	Report Writing.	Edward Arnold Ltd.
9	Collacott	Mechanical Fault Diagnosis.	Chapman & Hall.
10		Recommended Practice for the Protection and Painting of Ships.	British Ship Research Asso.
<u>11. NAUTICAL ENGLISH</u>			
1	Mac Eman, W.A.	Encyclopedia of Nautical Knowledge.	Cornell Maritime.
2		Chambers Twentieth Dictionary.	WR Chambers.
3	Sonnenburg	Radar and Electronic Navigation.	Butterworth.
<u>12. SHIP CONSTRUCTION, STABILITY &amp; NAVAL ARCHITECTURE</u>			
1	EA Stoke	Naval Architecture for Marine Engineers Vol. 4.	Reed's series.
2	Muckle, W.	Design of Aluminium Alloy Ship's Structure.	Hutkinson of London.
3	D'Arcangelo.	A Guide to Sound Ship Structure.	Cornell Maritime.
4	Holiday, G.V.	Ship Repair and Alternation.	"
5	La Dage, J.H.	Merchant Ship: A Pictorial Study.	"
6		Element of Ship Design.	Institute of Marine Engineers.
7		Ship Maintenance-A Quantitative Approach.	"
8		Ship and Naval Architecture.	"
9	Taylor	Merchant Ship Construction.	Butterworth.

NO.	Author	Title	Publisher
		<u>13. SAFETY</u>	
1		Hygiene	JICA.
2		Fire Fighting Equipment and Its Uses in Ship.	Institute of Marine Engineers.
		<u>14. NAVIGATION</u>	
1	Richard P.	How to Abandon Ship.	Cornell Maritime.
2		Maritime Law.	JICA.
3		Boat.	"
4		Navigation I.	"
5		Navigation II.	"
6		Marine Transport & History.	"
		<u>15. SHIP BUSINESS</u>	
1	J.W. Massenburg	Marine Hull Insurance for Operation Personnel.	Institute of Marine Engineers.
2		Business Management I.	General Publication.
3		Business Management II.	"
		<u>16. GENERAL TOPIC</u>	
1		Binder for Volume 1 and 2.	Institute of Marine Engineers.
2		Marine Surveying: Basic Aim.	"
3		Glossary of Marine Technology Terms.	"
4		Merchants Ship Type.	General Publications.
5		The Coal was There for Burning.	"
6	Brebbia/Walker	Dynamic Analysis of Offshore Structures.	Butterworth Marine Engineers.
7	Branch	The Elements of Shipping.	Chapman & Hall.

## OTHERS

1. Instructional Films + Video Cassettes
  - i. Fuel Valve, Overhaul (K-EF Engines)
  - ii. Fuel Valve, Replacement and Overhaul (K-EF Engines)
  - iii. Fuel Pump, Overhaul (K-EF Engines)
  - iv. Starting Valve, Replacement and Overhaul (K-GF Engines)
  - v. Piston, Replacement (K-GF Engines)
  - vi. Chain (Checking and Adjusting)
  - vii. Piston and Piston Rod Stuffing Box, Disassembly and Assembly (all K & L Engines)
  - viii. Introduction to the Two-Stroke Marine Diesel Engine
  
2. Slide Films Projector
  
3. Overhead Films Projector
  
4. Models
  - a. Flexible coupling for steam turbine
  - b. Various kinds of ship's steering rubber
  - c. Schounider propeller
  - d. Various kinds of ship's shape
  - e. Nuclear reactor S: 1/16
  - f. Variable pitch propeller
  - g. Boiler fuel oil burning system
  - h. Steam turbine (Impulse)
  - i. Steam turbine (Reaction)
  - j. Steam turbine plant
  - k. 2-Drum D-type water tube boiler
  - l. 2-Stroke cycle diesel engine (Uniflow type with supercharger)
  - m. 4-Stroke cycle diesel engine (with supercharger)
  - n. Ship's lighting system



## 5. Skeleton Diagrams

- Controllable pitch propeller type SI
- Pneumatic F/R remote control
- Level automatic control system
- Marine steam turbine (STAL-HAVAL)
- Jump scavenging system with turbocharger (SULZER)
- Voitch Schnaider propeller
- Pressure automatic control system
- Temperature automatic control system
- Combustion apparatus for boiler
- Heat balance diagram of tanker
- Closed feed water system
- 4-Stroke cycle diesel engine
- Boiler safety valve
- Loop scavenging system with turbocharger (MAN)
- Fuel pump (Spill valve type)
- Electric cargo winch
- Automatic voltage regulator
- Air circuit breaker
- Uniflow scavenging system in 2-cycle (B & W)
- Bosch fuel pump
- Cockran boiler
- Cylindrical boiler
- Sectional drawing for A.C. generator
- " " " D.C. "
- Generator panel diagram

(14) TRAINING THAT ARE DIFFICULT TO CARRY OUT

4.7.1 Marine Engineering Practice (MEP), (theoretical).

This subject should be taught by qualified marine engineers (holder of Certificate of competency in marine engineering) at least at second class certificate level.

4.7.2 Marine Workshop Practice (Practical)

The Marine Engineering Course at Politeknik Ungky Omar, Ipoh, is recognised as a cadetship training scheme for Marine Engineers in Malaysia.

Our basic aim here is to train operating Marine Engineers and not Design Marine Engineers (like those conducted in the University Of Technology, Malaysia). Therefore we need the service of at least one professional Marine Engineer to help us achieve our goals, that is to train students.

1. to develops the technical profeciency necessary to operate all system under the cognizance of the Ship Engineering Department,
2. to perform the necessary maintenance and repair function on equipment and system under the jurisdiction of Marine Engineering Department,
3. to apply engineering principle and commonsense to the solution of problem affecting the technological need of the ship.

We attemp to achieve the first two of the stated goals through our marine workshop practice curriculum which is focused on a set of lectures and laboratory experiments such as procedures for starting main diesel engine and also trouble shooting and overhauling works. In this area we find difficulty without the assistance of experienced marine engineers.

There is also the need to prepare and instruct our 2nd. year students in the proper practical aspect of what to expect when they start their career at sea. A proper instruction and guidance in this respect can only be provided by practising marine engineers.

We also need the services of these category of engineers to help maintain the marine machinery in our workshop in good working conditions.

(16) ESTIMATED PRICE OF REQUIREMENT FOR SPARE PARTS

( This list shows price in Japan.)

1985.7. 18

1. 2 Cycle Diesel Engine

\* Maker: Akasaka Diesels Ltd., tel.No. 05462-7-2659  
 \* Agreed time for delivery: 2 months

	Estimated Price @	
a) Exhaust Gas Turbine Charger		
* Bearing ( for blower side )	M\$ 500.	
* " ( for turbine side )	M\$ 950.	
* Labyrinth ( for blower side )	M\$ 570.	
* " ( for turbine side )	M\$ 640.	
* Inside Gas Labyrinth	M\$ 950.	
* Rotor Shaft	M\$24,000.	
* Blower Rotor	M\$12,000.	
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	Total	M\$39,610.
b) Cylinder Lubricator	M\$ 330.	
c) New Set of Reducing Valve & Oil Cup Assembly for Starting Air	M\$ 610. M\$ 150.	
d) F.O. Pressure Gauge	M\$ 100.	
e) Bosch Type F.O. Pump	M\$ 900.	(3 months)
f) Pilot Air Valve	M\$ 1,120.	
g) Fuel Injector/ Tip & Needle Valve	M\$ 270.	
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	Total	M\$ 3,480.

Item No.1 Total M\$43,090.

2. Fresh Water Generator

\* Maker: Sasakura Engineering Co. Ltd.,  
 \* Agreed time for delivery: 3 months  
 a) Fresh Water Generator Cooling Tube Nest M\$ 2,600.

3. Steam

a) Flow Meter Condensate.  
 \* Maker: Oval Engineering Co.Ltd, tel.No.03-360-5141  
M\$ 750. stocked

4. Boiler

a) Rotary Burner  
 \* Maker: Sunray Reinetsu Co.Ltd.,  
 \*Agreed time for delivery: 3 months  
M\$ 7,500.

b) Manhole Packing  
 \* still unknown the Maker  
 \*A.T.D. : 2 months M\$ 200.

5. Turbo Charger Electric Tachometer

\* Maker: Akasaka Diesels Ltd., M\$ 820. (Transmitter & Reciever

6. Load Cell of Water Brake Dynamometer	
* Maker: Akasaka Diesels Ltd.,	
*A.T.D.: 2 months	M\$ 500.
7. Air Ejector Nozzle	
* Maker: Shin Nippon Machinery Co.Ltd.,	
* A.T.D.: still unknown	M\$ 1,000.
9. CO <sub>2</sub> Meter ( Complete Assembly )	
* Maker: Mitaka Instrument Co. Ltd.,	M\$ 2,000.
10. Manual Expansion Valve for Refrigerator Machine	
* Maker: Fuji Koki	M\$ 300.

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Item No. 2---10 Total M\$ 15,670.

Grand Total M\$ 58,760.

## ADDITIONAL SPARE PARTS' ESTIMATED PRICE LIST

1985. 7. 26.

No.	Name of Parts	Specification or Material	Estimated @ Price in Japan	Remark
1	Manual Expansion Valve for Refrigerator		M\$ 50.-	
2	CO <sub>2</sub> Gas Meter	MODEL 6140 RAUTER GAS ANALYZER	New Complete @ M\$12,000-  Repair ( needs return transportation between Malaysia and Japan ) M\$ 4,308-	
* both above prices including export packing charge				
3	Air Ejector Nozzle	SUS 50	M\$ 480-	working 2 pcs.
4	Rotary Burner (inner parts)			including seal-packing & driving- belt
5	Boiler Manhole Packing	ASBESTOS	M\$ 20-	
6	Parts for Fresh Water Generator			
	1) Packing for Flash Nozzle	Rubber	M\$ 1-	
	2) Diaphragm for Spring Loaded Valve	for Condensate Pump Deliver	M\$ 1.5-	
		for Brine Pump Deliver	M\$ 16-	
	3) Casing Ring for Condensate Pump	Leaded Bronze ( LBC4 )	M\$ 20-	
4) Casing Ring for Ejector Pump	ditto	M\$ 24-		

ADDITIONAL SPARE PARTS' ESTIMATED PRICE LIST

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	5) Ballance Ring for Ejector Pump	ditto	M\$ 26-	
	6) Casing Ring for Brine Pump	ditto	M\$ 24-	
	7) Mechanical Seal for Condensate Pump (Complete)	NOK EA 110A 25	M\$ 55-	
	8) Root-cock for Vacuum Gauge	Bronze	M\$ 20-	
7	Labyrinth Packing for Steam Turbine	Ni-Pb etc..	M\$ 680-	working 12 pcs.

MAKERS' LIST OF MACHINERY DONATED BY JICA ( in relation to requirement for spare parts by P.U.O. )

1985. 7. 24.

Name of Machine	Name of Maker	Address of Makers	Tel. No.	Comment
2Cycle Diesel Engine	Akasaka Diecele Ltd.,	Technical Department for the attention Mr. T. Komiyama or Mr. O. Yamachita 3, 3, 11, Nakaminato, Yajuzu-shi, Shizuoka Pref. 425 Japan	05462-7-2125	Telex No. 03962-955 AKADSL J Fax. No. 05462-7-2659
Fresh Water Generator	Sasakura Engineering Co. Ltd.,	Sasakura Service Center Co. Ltd., 34-4, Kitashinagawa 2 Chome, Shinagawa-ku, Tokyo 140 Japan	03-471-0731 (key number )	Telex No. 222-2351 Fax.No. 471-0717
Flow Meter Condensate.	Oval Engineering Co.Ltd.,			
Boiler ( Body )	Ando Iron Works			
Rotary Burner	Sunray Reinetsu Co.Ltd., Osaka			
Steam Turbine	Shin Nippon Machinery Co. Ltd.,	Export Department 2nd Floor, Seiou Building, 1-28, Shiba 2 Chome, Minato-ku, Tokyo 105 Japan for the attention Mr. W. Kohashi, manager of Export Section	03-454-1411, 1412	Telex No. 242-4302 SNZOKI J Fax.No. 03-454-1410
CO <sub>2</sub> Meter ( 6140 RAUTER GAS ANALYZER )	Mitaka Instrument Co. Ltd.,	11-19, Nakacho 2 Chome, Munashino-shi, Tokyo 180 Japan	0422-52-3721	
Expansion Valve for Refrigerator	Fuji Koki Manufacturing Co. Ltd.,	17-24, 7 chome, Todoroki, Setagaya-ku, Tokyo 158 Japan	03-702-5141 ( key number )	Head Office & Foreign Trade Division Telex No. 2468231 FUJIK J

(16) UTILIZATION, MAINTENANCE, AND MANAGEMENT OF FACILITIES  
AND EQUIPMENT (INCLUDING THESE DONATED BY JICA)

a) List of the equipment

No.	Equipment	Model	Maker	Q'ty
1	Steam Turbine with Accessories	CCR-40	Shin Nippon Machinery Co. Ltd.	1
2	Water Tube Boiler with Accessories	SAP-720	Ando Iron Works Co. Ltd.	1
3	4-Stroke Cycle Diesel Engine Coupled with A.C. Generator with Accessories	5KL	Yanmar Diesel Engine Co. Ltd.	2
4	2-Stroke Cycle Diesel Engine with Accessories	3 UET 33/55	Akasaka Iron Works Co. Ltd.	1
5	Auxiliary Machines and Electrical M/c, General Items			
	1. A.C. Generator Panel with Accessories	Engine No. 21664 Capacity 80KVA	Taiyo Electric Mfg. Co. Ltd.	2
	2. Motor Generator with Accessories	Engine No. Motor 68368 Motor: IT 7325, 3.7KW, 415V, 3Ø Generator No. 70664, DC Compound, 2KW, 105V	Taiyo Electric Mfg. Co. Ltd.	1



No.	Equipment	Model	Maker	Q'ty
3.	Motor Generator with Accessories	Engine No. Motor 68418 Motor: IT 7325, 3.7KW, 415V, 3Ø Generator No. 70663 DC Compound, 2KW, 105V		1
4.	M-G Panel with Accessories	Engine No. 21865	Taiyo Electric Mfg. Co. Ltd.	1
5.	Induction Motor with Accessories	Engine No. 68370 Star-Delta Starting, 3.7KW, 415V, 1500 rpm	Taiyo Electric Mfg. Co. Ltd.	1
6.	Induction Motor with Accessories	Engine No. 68369 Direct Starting, 3.7KW, 415V, 1500 rpm	Taiyo Electric Mfg. Co. Ltd.	1
7.	D.C. Motor with Accessories	Engine No. 670665 Shung, 0.75KW, 105V, 1800 rpm	Taiyo Electric Mfg. Co. Ltd.	1
6	D.C. Motor with Ward Leonard System Panel with Accessories	Engine No. 670666, Panel: 36096 Motor: Comp. 0.75KW, 105, 105V, 18000 rpm	Taiyo Electric Mfg. Co. Ltd.	1
7	Electric Power Circuit System	Engine No. 21866	Taiyo Electric Mfg. Co. Ltd.	1
8	Pre-fabricated Cold and Freezing Room with Standard Accessories Refrigerator Parts	Drain Cock, 16K-6 Drain Valve 20K-16A Valve, 5K-15A, FA Freezer (Mitsubishi; type 7V-22U)	Tajima Reiki	
9	Electric Hydraulic Steering Gear for Twin with Accessories	Engine No. 5210	Kitagawa Kogyo Co. Ltd.	1

No.	Equipment	Model	Maker	Q'ty
10	Oil Purefire Unit with Accessories	Engine No. 4071572 Model: SJ700	Mitsubishi Chemical Machinery Mfg. Co. Ltd.	
11	Pump with Accessories	Engine No. P5167896, 53754619 Model: EBARA 65 SGM	Ebara Mfg. Co. Ltd.	
12	Pump with Accessories	Engine No. P5167897, 53754596 Model: EBARA 50 MS III M.	Ebara Mfg. Co. Ltd.	
13	Synthetic Hydro-experimental Machine with Accessories	Engine: 75450 Model: WDS-3Y	Kikai Kenkyu Ltd.	1
14	Electric Chain Block	D type		
15	Flowmeter with Accessories	Model: LS5277		1
16	CO <sub>2</sub> Gas Analyzer with Accessories	Engine No. 71323 Model: GPIS Portable type	Mitaka Instrument Co. Ltd.	1
17	Pressure Gauge		Nagaho Keiki Seisakusho Ltd.	1
18	Pressure Gauge Tester with Accessories	Engine: 2893 Type : PI Dead Weight Range : 0.5 - 50kg/cm <sup>2</sup> Press : 50kg·cm <sup>2</sup>	Nagaho Keiki Seisakusho Ltd.	1

No.	Equipment	Model	Maker	Q'ty
19	Flash Point Tester	Pensky & Martin type		1
20	Orsat Gas Analyzer with Accessories	Model: OC3		
21	Servo Expirement Equipment with Accessories		Yamato Electronic Co. Ltd.	1
22	Turbo Blower			
23	Electric Cable	For 660V use.		
24	Pump Model WLP-10	Model: WLP-10		
25	Distilling Unit	Engine No. 61001 Type: Sasakura Type: F-10 SAU	Sasakura Engineering Co. Ltd.	1
26	Details of Distilling Unit		Sasakura Engineering Co. Ltd.	1
27	Cooling Tower with Accessories	Capacity 1800 kcal/h	Hitachi Co. Ltd.	
28	Tools for Cooling Tower		Hitachi Co. Ltd.	
29	Motor Pump (11KW) for Cooling Tower	Engine No. Motor No. 366085, Pump No. 3269738 Seiko Cooling Tower Parts	Seiko Kakoki Co. Ltd.	

No.	Equipment	Model	Maker	Q'ty
30	Cutter	No.1 and 2		
31	Hydro Cargo Winch with Accessories	Engine No. HNA 4431 (Motor) IHI Capacity: 3 tons, 30m/min. Motor: 30KW	Setozaki Iron Works	1
32	Electric Cargo Winch with Accessories	Engine No. 2H 60 40 P 6101, W/O-835 Capacity: 3 tons 30m/min. Motor: 18.5KW	Mitsubishi Electric Corp.	1
33	<u>Meter</u> Vibration Meter	Engine No. 6482 Model: GIV	Umekita Mfg.	
	Plain Meter	Engine No. 9737, 9738, 9740, 9821, 22675		
34	Flow meter			
35	Transistor Mega	Type: National BN 500TB		5
36	Multistester	Type: Sanwa ST-10		5
37	Clamp Meter	Type: National BT1102		

No.	Equipment	Model	Maker	Q'ty
38	Rotary Meter	Type: M.K.W. No. 4711 Type: HL No. 27749 Type: A-5D2 No. 135643	Komineseisakusho Ltd. Asahi Keiki Seisakusho Ltd. Uchiyamaeiki Seisakusho Ltd.	1 1 1
39	Camera	Type: Cannon G-3-17		
40	Henni Slide Rule	Type No. 259D		2
41	National High-Powered Light - National caplight - Conves rule			5 5
42	Life Jacket	Type: SK-2B Type: KSK-5-4		50 40
43	Safety Shoes			
44	Water Quality Analyzer Kit	Type: MA-1	Kurita Water Industries Ltd.	
45	Engine Indicator	Engine No. 36246, 36254, 47928 Type: W3 Type: M3 Engine No. 88626, 88667 Type: M-2	Nagano Keiki Seisakusho Ltd. Nagano Keiki Seisakusho Ltd. Nagano Keiki Seisakusho Ltd.	2 1 2

No.	Equipment	Model	Maker	Q'ty
46	<u>Drawing Set</u>			2
	T. rule			2
	Triangle rule			2
	Kumogata rule			2
47	Portable Electric Calculator	Engine No. 102506 Type: Canola LI631	Canon Incorporation	1
	Typewriter	Engine No. 4124761 Type: LINEA98	Olivetti in Italy	1
	Typewriter	Engine No. 9380724 Model: M-300	T-A Organization	1
	Electronic Calculator	Engine No. 250772 Model: SOBAX ICC-200E	Sony Corporation	
48	Tape Recorder	Engine No. 140688 Model: TC-357A	Sony Corporation	
	Slide Projector	Engine No. 251302338	Cabin	
49	Master Overhead Projector with Accessories	Eng. No. 21876 (Lens No. 11903) Type: Master-S-250 DE	Rikagaku Seiki Co. Ltd.	
50	Ph Meter with Accessories	Engine No. 361-05261 Type: NPH	Shimadzu Scientific Instrument Ltd.	1
51	Viscometer with Accessories	Engine No. 361-05233-02	Shimadzu Scientific Instrument Ltd.	1

No.                      Equipment                      Model                      Maker                      Q'ty

52	Hydrometer with Accessories	Engine No. 361-12185 Type: HD-50	Shimadzu Scientific Instrument Ltd.	1
53	Vibration Meter with Accessories			
54	Overhead Projector with Accessories Transformer	Engine No. 508128 Type: FUJICS 0 HP900 Type: Fuji x 500	Fuji Photo Film Co. Ltd.	
55	Film			
56	Electronic Trainer	Model: ET-P3	Yamato Electronics Co. Ltd.	
57	Reference Book			
58	Toyota Corona Mark II 2000 Station Wagon	Engine No. 18r-0762076 Chassis No. Rx-28-0-014806 Type: Rx 28-KR 1974	Toyota Motor	
59	Equipment for Technical Guidance			
60	Model and Wall Map for Education		Meiji Sangyo Co. Ltd.	1
61	Universal Machine	Takisawa TCM-6A	Takisawa	1
62	Engine Lathe	Takisawa TAL 510 x 1000	Takisawa	1

No.	Equipment	Model	Maker	Q'ty
63	Upright Drilling Machine	Kiwa KUD-550 FS		2
64	AC Arc Welding Machine	KRCE 300	Osaka Transformer	5
65	Grinder, Drill, File			
66	Lifebuoy	Nihon Kyumei Kigu P-22		
67	Turbo Fan	Onishi OTF-No.3		
68	Evaporator			
69	Baby Compressor	Type: OBP-7T(L)	Hitachi	1
70	Devices for Automatic Control Practice		Yokogawa Electric Works Ltd.	1 set



## (17) REQUIREMENT FOR SPARE PARTS

No.	Items	Specification	Maker	Comment
1.	TWC CYCLE: D/E			
	a) Exhaust Gas Turbine Charger (Turbo Charger).	DZH 315 S5 M2	Mitsubishi Heavy Industry.	Not Functioning
	b) Cylinder Lubricator and Driving Gear	Model,MLHC-IR-6B Port.6, DIS-0.3 cc/St Pres.80Kg/cm <sup>2</sup> Cap-1.5l.	Yamashina Seiki and Akasaka Iron Works	Leaking.
	c) New set of reducing valve and oil cup assembly for starting air.	WTP 60 Kg.		Not Functioning
	d) Fuel Oil Pressure Gauge	Range- Kg./cm <sup>2</sup> Dia-6cm(Nagano 6207497)	Akasaka	Broken.
	e) Bosch Type Fuel Pump	NP-PFIW 190/99 Np 4 Ass'y No.4055-004	Diesel Kiki Tokyo, Japan	Spare.
	f) Pilot Air Valve.			Spare.
	g) Fuel Injector/tip and Needle Valve.	UE 33,7211,039-8-68		Broken.
2.	FRESH WATER GENERATOR:			
	a) Fresh Water Generator Cooling Tube (Nest).	Oasis-F-10 SAU-R.	Sasakura Engineering Company Limited.	Spare.

No.	Items	Specification	Maker	Comment
3.	STEAM: a) Flow Meter Condensate.	Flow Meter-200-L200L/h Max.Press.10Kg. Size 20mm. Max. Temp. 110°C No.40002 LS 5377.	Oval Engineering.	Broken.
4.	BOILER: a) Rotary Burner.	Sunray Man Type RBS 2.5 Cap.270 Liter/Hour. Motor Cap. 1.5 Kilo Watt. Manufacturing No.H 490222.	Sunray Reinetsu Co. Ltd. Osaka.	Spare.
	b) Man Hole Packing.	ANDO SAP -720 Boiler.	ANDO IRON work.	Spare.
	c) Mechanical Tools For Cleaning of Boiler Tubes and Tube Expendor For Repair.			
	d) Boiler Water Analysis Kit.			
5.	Limit Switches, Magnetic Contactor, Pressure Gauges, Packings etc.			
6.	Turbo Charge Electric Tachometer.			Suspect Not Functioning.
7.	Load Cell of Water Brake Dyna mometer.			Not Functioning
8.	New Set of Air Ejector for Steam Turbine			

II - Requirement For After Care Service

Service Of Expert/Specialist For:

1. 2 Cycle Engine:  
Inspection, repair and testing of main engine remote control system and Telegraph (wiring and piping repairs).  
Type: E-10 Meiyo Electric Company Limited-
2. Complete Overhauling, (Survey) and testing of main engine (Including servicing of fuel pump, checking of timings and performance test).
3. Design and Fitting of Control Air Dehydrator in the starting air system.
4. Checking of:
  - a) Starting air system.
  - b) Control air system.
  - c) Pneumatic and Electric Control System for remote control operation.

(18) LIST OF COUNTERPARTS

No.	Name	Category	Aca. Qualification	Training Undergo During Service
1.	Mustapar Bin Muhamad	DI	B.E. (Mech.) (Australia)	<ol style="list-style-type: none"> <li>1. Six month training in Japan in Marine Engineering</li> <li>2. One month in education Management and Curriculum Development (UK).</li> <li>3. Twelve months sea training (MISC).</li> <li>4. Attend QCC course organized by INTAN.</li> <li>5. Attend Seminar for Heads of Maritime Institution in Developing Countries in Sweden.</li> <li>6. Attend Colombo Plan Staff College Singar in Country Course in Kuantan Pahang.</li> </ol>
2.	Mohd. Hashim Bin Buyong	DI	B. Sc. Mech. (UK) Dip. in Mech. Eng. (ITK) Cert. in Mech. General (PUO)	<ol style="list-style-type: none"> <li>1. In Country course - Evaluation of Curriculum Implmentation two weeks (PUO).</li> <li>2. Workshop and Seminar Maritime Training Institute in ASEAN Management and Meteology three weeks at ALAM, Melaka.</li> <li>3. Attending short - nine months (UK) (Presently attending course)</li> </ol>
3.	Azaman Bin Hassan	DI	B. Sc. Mech. (UK) (Marine Options) Dip. Kej. Jentera (ITK) Certificate in Production Eng. PUO.	<ol style="list-style-type: none"> <li>1. Japanese Language Course at ITM - six months.</li> <li>2. In Plant Training in Japan four month.</li> </ol>

No.	Name	Category	Aca. Qualification	Training Undergo During Service
4.	Mohd Sopian Bin Bahauddin	DI	B. Sc. (Mech.) (UK) (Marine Option) Certificate Mech. Eng. (Airconditioning & Ref.) PUO. Teaching Cert-Central Training Institute for Instruction India in Air Conditioning & Ref.	
5.	Misri Bin Darmono	DI	B. Sc. Mech. (UTM) Dip. Mec. Eng. (ITK) Cert. Mech. Production (PUO)	1. Three weeks on board MISC ship.
6.	Arshad Bin Yusof	T1	Dip. in Elect. Engineering (Power) (UTM)	1. Japanese Language Course at ITM five months. 2. In Plant Training in Japan.
7.	Mohammed Zulkifli Mohammed	T1	Dip. in Marine Engineering (PUO)	-
8.	Mohana Krishnan a/l Gobalakrishnan	T1	Dip. in Mech. Eng. (UTM)	-
9.	Mohd. Nasruddin Bin Abd. Muaid	T4	Dip. in Marine Engineering (PUO)	-
10.	Ridzuan Bin Md Daud	T1	Dip. in Marine Engineering (PUO)	-

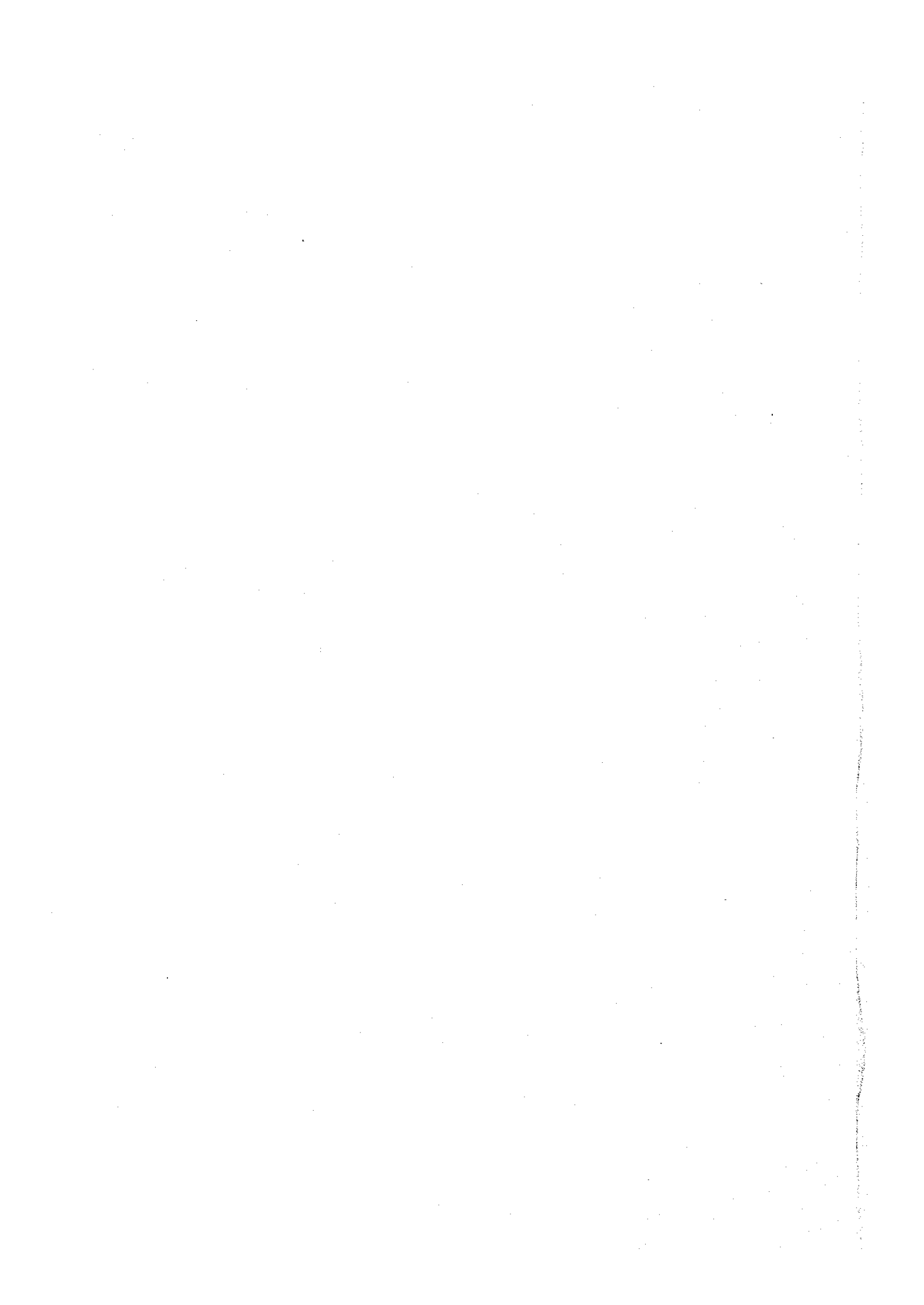
No.	Name	Category	Aca. Qualification	Training Undergo During Service
11.	Liew Siew Men	T2	Tech. Teachers Cert. (Incls. Arts) TTTC C & G Mec. Eng. Crafts Prac. Part 1 & 11 (UK) C & G Mech. Eng. Tech. Part 1 & 11	1. Six months in tool making
12.	Kamaruddin Bin Ajib	T2	Tech. Tec. Cert. (TTTC) Dip. in Tech. & Voc. Educ. (Canada)	1. Auto Diesel course in Toronto.
13.	Hussein Bin Youno	T2	Tech. Teachs. Weld. Eng. Cert. in Teachers Training Tech. College (TTCKL)	1. Welding & Air Conditioning course in TTCKL. 2. Seminar for Career and Guidance for Youth USM.
14.	Ismail Bin Hashim	Tech.	Ordinary National Dip. (Mech. Eng.) Cambridgeshire College of Arts Tech. Cambridge UK.	1. Three weeks sea training on board MISC ships. 2. One week in plant training (Boiler) at IBAE Malaysia.

\* No. 7, 9, & 10 are the graduated of P.U.O.

\* No. 11-14 are instructors.

## (19) ACTIVITIES OF COUNTERPARTS

No.	Name	Age	No. of Years of Service	No. of Lecture Hours per Week Subject (Hours)	Status	Other Activities
1.	Mustapar Bin Muhamad	34	9	2.25	Head of Department	
2.	Mohd. Hashim Bin Buyong	34	6	Nil	Asst. Head of Department	Examination Coordinator.
3.	Azaman Bin Hassan	35	6	3.75	Graduate Lecturer	
4.	Mohd. Soplan Bin Bahauddin	32	5	8.25	Graduate Lecturer	Class Lecturer.
5.	Misri Bin Darno	35	2	6.75	Graduate Lecturer	Class Lecturer.
6.	Arshad Bin Yusof	27	2	11.25	College Lecturer	Statistic/Record of Students Attendance Coordinator.
7.	Mohamad Zulkifli Bin Mohamad	28	3	6.75	College Lecturer	Workshop Practice Coordinator. Correspondence Course Coordinator.
8.	Mohana Khishana a/l Gobalakrishnan	25	3	9	College Lecturer	First Aid Course Coordinator.
9.	Mohd. Nasruddin Bin Abd. Muaid	24	2 months	3.75	College Lecturer	Workshop Practice.
10.	Ridzuan Bin Md Daud	24	2 months	3.75	College Lecturer	Workshop Practice.
11.	Liew Siew Men	38	3	2.25	College Lecturer	Workshop Practice.
12.	Kamaruddin Bin Ajib	28	2	Nil	Instructor	Workshop Practice.
13.	Hussien Bin Youno	25	1	1	College Lecturer	Workshop Practice.
14.	Ismail Bin Hashim	28	1	2.25	Technician	Translation/Original Manuscrip Coordinator.









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