Suppliment tal-Gazzetta tal-Gvern ta' Malta Nru. 13,894, 9 ta' Ottubru, 1981
Taqsima B

L.N. 108 of 1981

MERCHANT SHIPPING ACT, 1973

(ACT NO. XI OF 1973)

Merchant Shipping (Certification of Marine Engineer Officers) Regulations, 1981

IN exercise of the powers conferred by sections 92 and 374 of the Merchant Shipping Act, 1973, the Prime Minister has made the following regulations:—

Citation.

1. These regulations may be cited as the Merchant Shipping (Certification of Marine Engineering Officers) Regulations, 1981.

Interpretation.

2. In these regulations, unless the context otherwise requires —

"First Engineer" means First Class Engineer of a Motorship;

"Motorship" means a ship propelled by internal combustion reciprocating engines;

" prescribed fee" means the appropriate fee prescribed in the Merchant Shipping (Fees) Regulations, 1973;

"Second Engineer" means Second Class Engineer of a Motorship.

Conditions for the grant of certificates of competency.

3. A certificate of competency as First Engineer and Second Engineer, shall be granted by the Registrar-General on payment of the prescribed fee, to any person who —

(a) in any case has passed the examination conducted in terms of the rules set out in the First Schedule to these regulations:

Provided that the Registrar-General may, under such canditions as he may deem fit to impose, exempt from the whole, or from any part of the relative examination, any person who proves to the satisfaction of the Registrar-General that he has passed an examination which, in the opinion of the Registrar-General, is equally efficient to the requirements of these regulations;

(b) has performed to the satisfaction of the Registrar-General the necessary qualifying sea service specified in the Second Schedule to these regulations;

(c) has given evidence to the satisfaction of the Registrar-General of his sobriety, experience, ability and general good conduct on board ship;

(d) has undergone such medical tests as may be, from time to time, prescribed by the Registrar-General to ascertain that his hearing, speech, physical and mental condition are such as to render him capable of discharging adequately the sea-going duties pertaining to his grade;

(e) holds a valid first aid at sea certificate to the satisfaction of the Registrar-General;

(f) in the case of a First Engineer, holds a valid certificate of competency granted, to the satisfaction of the Registrar-General,

under the same conditions as certificates of competency as Second Engineers are granted in terms of these regulations;

(g) in the case of a Second Engineer —

(i) has completed to the satisfaction of the Registrar-General the initial training requirements set out in the Third Schedule to these regulations; and

(ii) has attended to the satisfaction of the Registrar-General an approved fire-fighting course and an approved lifeboat and life saving appliances course.

Duration of certificate of competency.

4. (1) A certificate of competency issued under these regulations shall be valid for five years subject to be renewed after the lapse of the first or any subsequent period of five years.

(2) Subject to the provisions of this regulation, the Registrar-General shall renew a certificate of competency issued under these regulations on application and on payment of the prescribed fee, unless —

(a) the said certificate has been cancelled by order of any of the Courts of Malta, or

(b) at the time of application for renewal, the said certificate has been suspended by order of any such court.

(3) The Registrar-General, before renewing a certificate of competency issued under these regulations, may, in order to ascertain that the holder of the certificate is still capable of adequately discharging the duties pertaining to his grade, require the holder of the certificate to take such tests or examinations as are at the time appropriate to his grade.

Surrender of certificate of competency.

5. Where the holder of a certificate of competency of a particular class issued under these regulations is issued with such a certificate of a higher class, he shall surrender the first-mentioned certificate to the Registrar-General or to such person as the Registrar-General directs, for cancellation.

Lost or destroyed certificate of competency.

6. (1) If a certificate of competency issued under these regulations is lost or destroyed, the holder thereof shall, as soon as practicable, notify the Registrar-General who shall, if satisfied that it has been so lost or destroyed, issue a copy of the certificate of competency (so marked) against payment of the prescribed fee, and such certificate shall have the same effect as the certificate of competency originally issued.

(2) Any certificate notified as aforesaid as lost or destroyed, shall, if subsequently recovered, be delivered forthwith to the Registrar-General.

Forgery of certificates of competency.

7. The provisions of sections 98 of the Act shall apply in relation to certificates of competency issued under these regulations.

Application to certificates of competency issued under section 94 of the Act.

8. The provisions of these regulations applicable to certificates of competency issued under these regulations shall also apply to certificates of competency as First Engineer and Second Engineer issued under section 94 of the Act.

FIRST SCHEDULE

Regulation 3

Examination for the Grant of Certificates of Competency as First Engineer and Second Engineer

Admission to Examination

1. An application to take the said examination shall be made to the Registrar-General on a form supplied by him, which form, subject to the provisions of this regulation, shall be accompanied by —

(a) the applicant's certificate of birth;

(b) certificate of discharge, and such other certificates as may be necessary to establish, to the satisfaction of the Registrar-General, that the applicant has performed the necessary qualifying service; and

(c) in the case of First Engineer, a valid certificate of competency as Second Engineer.

2. Every such application duly completed shall be lodged with the Registrar-General who shall —

(a) if satisfied that the applicant is eligible to take the examination, take note of this application, inform him of the date when, and the place where the examination will be held, and return the applicant the certificates which accompanied the application; or

(b) if not so satisfied inform the applicant accordingly in writing, stating the grounds on which the application is refused, and return to him the certificates.

3. The Registrar-General shall inform the Administrative Secretary of the arrangements made for the holding of the examination in accordance with these regulations and if the Administrative Secretary is so satisfied he shall authorise the examination to be held.

4. The Registrar-General shall inform the Administrative Secretary of the result of the examination and if the Administrative Secretary is satisfied that the examination has been properly held in accordance with these regulations he shall authorise the Registrar-General to inform the candidates of the result of the examination.

5. A candidate may apply to take either the whole of Part A of the examination for First Enginer or Second Engineer certificates or, if exempted from certain subjects, the remaining subject or subjects at any time after he has completed the training set out in the Third Schedule to these regulations, except in the case of an examination for a First Engineer certificate when he must in addition be in possession of a Second Engineer Certificate.

6. A candidate may present himself for Part B of an examination at any time after he has completed the necessary period of qualifying sea service provided that he also takes at the same time the whole of the Part A examination unless he has previously completed the Part A examination or has been exempted from it.

7. A candidate who is successful in passing any subject may not be required to resit that subject at as subsequent attempt.

Re-examination

8. A candidate who fails in any part of the examination may present himself for re-examination at any subsequent examination subject to no penalty under paragraph 9 or 10 of this schedule being enforced.

Penalty for failure in the Engineering Knowledge Examination

9. A candidate who shows ignorance of topics which are vital to an Engineer Officer's duties and are such that if neglected could lead to acts or ommissions whereby life and/or ship is endangered, will not be accepted for re-examination until he has performed a further period of twelve months sea service.

10. A candidate who, during three attempts at the Engineering Knowledge examination shows no improvement in his engineering knowledge will not be accepted for re-examination until he has performed a further period of twelve months sea service.

Breach of Examination Rules

11. Candidates violating any of the examination rules will be considered to have failed and will not be accepted for re-examination for such a period as may be decided by the Registrar-General.

Examination Structure

12. The examination for a certificate of competency as Second Engineer is divided into two parts as follows:

Part A

Applied Mechanics (one paper of 3 hours)
Heat Engines (one paper of 3 hours)
Mathematics (one paper of 3 hours)
Engineering Drawing (one paper of 4 hours)

Part B

(I) Electrotechnology (one paper of 3 hours)
Naval Architecture (one paper of 3 hours)

(II) Engineering Knowledge (2 papers each of 3 hours)
Viva Voce examination

13. The examination for a certificate of competency as First Engineer is divided into two parts as follows:

Part A

Applied Mechanics (one paper of 3 hours)
Heat Engines (one paper of 3 hours)

Part B

(I) Electrotechnology (one paper of 3 hours)
Naval Architecture (one paper of 3 hours)

(II) Engineering Knowledge (2 papers each of 3 hours)
Viva Voce examination

14. The syllabuses for the examinations in the subjects specified in paragraphs 12 and 13 of this Schedule are set out in the Fourth Schedule to these regulations.

15. Candidates will be expected to obtain a minimum number of marks in each subject in the written examination and not less than one-half of the total number of marks to secure a pass. In the viva voce examination a somewhat higher standard will be required.

16. The examiners shall be appointed from among holders of certificates of competency in a grade not below that of a First Engineer.

SECOND SCHEDULE

Regulation 3

Qualifying Sea Service

1. Candidates for Certificates as Second Engineer must, in addition to the requirements for initial training set out in the Third Schedule to these regulations, have completed the following period of qualifying Sea Service in ships of not less than 746 KW power: twenty-one months, of which at least nine months must have been spent on the main propelling machinery of a motor ship; the remaining period may have been spent on the main propelling machinery of a steam or motor ship, or on suitable auxiliaries of any ship or on day work.

2. Candidates for Certificates as First Engineer must, whilst in possession of a Certificate as Second Engineer have completed the same period of qualifying sea service as that required in paragraph 1 of this Schedule, such sea service having been in ships of not less than 3000 KW power.

Remission of qualifying Sea Service

3. For a certificate as Second Engineer candidates who have passed Part A of the examination for a certificate as Second Engineer or who have obtained a certificate, diploma or degree recognised by the Registrar-General as conferring full exemption from Part A of the Certificate for Second Engineer before starting qualifying sea service may be granted three months remission of qualifying sea service:

Provided that the last six months of this period of eighteen months' sea service may be performed after the taking of Part B of the examination referred to in these regulations, within a period specified by the Registrar-General, which period shall not exceed nine months from the date of the examination, on condition that until such time as the Registrar-General is satisfied that this service has been performed, the applicant shall not be considered as having passed the examination.

4. For a Certificate as First Engineer candidates who have passed Part A of the Examination for a Certificate as First Engineer or who have obtained a certificate, diploma or degree recognised by the Registrar-General as conferring full exemption from Part A of the Certificate as First Engineer before starting qualifying sea service may be granted three months remission of qualifying sea service.

General Provisions as to Eligibility

5. Except where otherwise stated, qualifying sea service means service under crew agreements as Engineer Officer on regular watch, i.e. on watch for not less than eight out of each twenty-four hours of service claimed, in ships with propelling machinery in full use.

6. When part or whole of the service has been performed in ships which for considerable periods have not been under way, a statement from the owners of the ship must be produced stating the time in days actually under way. In such circumstances qualifying sea service may be reckoned as one and a half times the number of days actually spent under way but in no case can it exceed the time spent on Articles during the period concerned.

7. In the case of candidates for the First Engineer examination this service should be performed as Engineer Officer in charge of the watch although service as second in seniority on ships where three or more Engineer Officers are on regular watch at the same time will be accepted but service of lower seniority in such ship will only be accepted at half rate.

8. Sea Service performed by Engineer Officers employed in work practices in ships operated on other than the traditional eight hour watchkeeping routine may be accepted as qualifying sea service if the Registrar-General is satisfied that such work practices provide a reasonably balanced system of service. Sea service falling within the scope of this paragraph will be assessed according to the following general principles:

When an Engineer Officer is nominated as being in sole charge of periodically unattended machinery spaces for a period of twenty-four hours, the time so spent on such 'on call' watchkeeping may be accepted at one-and-a-half rate, the remainder of the time on Articles will be considered as daywork and allowed to count towards qualifying sea service as detailed in paragraph 11 of this Schedule. The total sea service accepted under these conditions will be either that computed in accordance with this paragraph or the time actually spent on Articles, whichever is less.

9. Sea service in ships where a watchkeeping Engineer Officer, as part of his regular duties does work not usually performed by a Watchkeeping Engineer Officer in the Merchant Navy, is not generally acceptable. The Registrar-General will however consider cases where, although the work is of an unusual nature, it is considered pertinent to the operational experience of a Marine Engineer. In such cases the Registrar-General may accept the sea service up to a maximum of nine months, either at full rate, or at some proportional rate dependent on the type of work involved. Such sea service will not however be accepted as couting towards the minimum sea service required to be spent on the main propelling machinery of a motor ship.

10. Time spent on auxiliary machinery essential to the running of the main propelling machinery will be allowed to count in full towards qualifying sea service, this service being subject to a maximum acceptable limit of nine months. Time served on suitable auxiliary machinery run independently of the main propelling machinery will count at half rate, the total service so calculated is subject to a maximum acceptable limit of nine months.

11. Engineering work carried out within the engine and boiler spaces of a steam or motor ship at sea, other than that performed on regular watch, will be counted towards qualifying sea service as follows: up to eight months at full rate and any further period at half rate, the total service so calculated is subject to a maximum acceptable limit of twelve months.

12. Every candidate must produce testimonials in respect of his qualifying sea service. The testimonials, which should state the seniority on watch, the type of main propelling machinery and the nature of the duties performed, are to be signed by the Chief Engineer and to be endorsed by the Engineer Superintendent or by the Master or other representative of the owner.

When the candidate has acted in the capacity of Chief Engineer the testimonial(s) shall be signed by the company's Engineer Superintendent or a person of responsibility within the company.

13. When a candidate suffers from any physical or mental disability which might interfere with the proper performance of his duties as an engineer officer, the signatories of his testimonials should state whether such defect did in fact interfere in any way with the efficient discharge of the candidate's duties.

14. Sea Service which cannot be verified by proper entries in the Articles of Agreement of the ships in which the candidate has served will not be accepted, unless authenticated to the satisfaction of the Registrar-General.

15. The candidate's qualifying sea service as shown by his discharges and testimonials will be reckoned by the calendar month, i.e. the time included between any given day in any month and preceding day of the following month, both inclusive. The number of complete months from the commencement of the period, ascertained in this way, should be computed, after which the number of odd days should be counted. The day on which the agreement commences, as well as that on which it terminates, should both be included, all leave of absence excluded and all odd days added together and reckoned at thirty days to the month.

16. Candidates or potential candidates who, after having signed crew agreements have neglected to join their vessels, or who, after having joined, have left their ships other than upon discharge, or who have committed misconduct on board will be required to produce satisfactory proof of two years subsequent service with good conduct at sea, unless the Registrar-General after investigation, should see fit to reduce this period.

THIRD SCHEDULE

Regulation 3

Initial Training

1. Workshop training or other training before the age of sixteen years will not be accepted.

2. A candidate must have received one of the forms of training specified in paragraphs 3, 4, 5 and 6 below.

3. Training as Engineer Cadet. A candidate must have completed an approved course of cadet training. These courses normally of four years duration consist of two years academic study, one year sea-going service and one year Industrial Workshop experience and lead to the Marine Engineering Technicians Diploma or an equivalent qualification.

4. Training as an Engineering Craftsman. A candidate must have completed four ears engineering craft training. This period of service may include full time education betwen the ages of 16 and 17 years: it must include one year 'off the job' training in the use of tools and techniques of general engineering craft practice at an approved industrial training centre.

5. Training as Engineer Technician. A candidate must have completed four years training as an engineer technician during which time he must have obtained the Higher Technicians Diploma or an equivalent qualification, by part-time study and has undergone one year 'of the job' training in the use of tools and tecniques of general engineering craft practice at an approved industrial training centre.

6. Full-time technical college or university courses. A candidate must have satisfactorily completed a full-time course of study of at least the standard of a degree in Mechanical or Civil Engineering for a period of not less than three years at a Technical college or university, together with eighteen months' engineering training of relevance to the duties of a sea-going engineer officer.

Deficiency in Training

7. Any deficiency from the requiremnts of paragraphs 3, 4, 5 and 6 will be assessed in each case and must be made good by 'off the job training' or by further workshop service of a suitable character or by compensatory ship service as an Engineer Officer or trainee Engineer as the case may be.

8. Compensatory shipboard service must be performed either on regular watch or on day work in ships of not less than 350 KW power. Time so spent on such ships will be accepted as having two-thirds of the value of suitable workshop service. The period of compensatory shipboard service required will not exceed six years.

9. Compensatory sea service before the age of twenty years will not be accepted.

Testimonials

10. All candidates will be required to produce testimonials covering the service. These testimonials must be signed by the employer or his representative to the satisfaction of the Registrar-General. Testimonials will be returned to the candidates when the examination is completed.

FOURTH SCHEDULE

Regulation 3

Syllabuses

SECOND ENGINEER

Applied Mechanics

Statics. Force as a vector. Triangle and polygon of forces. Resultant and equilibrant of a system of concurrent coplanar forces. Equilibrium of three coplanar forces. Moment of a force. Couples. Moments of areas and volumes. Centroids and centres of gravity (limited to geometrical shapes). Conditions of equilibrium of solids. Necessary force applied parallel to an inclined plane to pull body up or down the plane or to hold it stationary (including effect of friction). Work done at uniform speed up the plane.

Friction. Coefficient of friction. Friction angle. Energy and power lost due to friction in simple bearings.

Kinematics. Linear motion. Graphs and equations for displacements, speed, velocity and uniform acceleration. Velocity as a vector. Relative velocities in one plane only. Angular motion. Equations for displacement, velocity and uniform acceleration.

Dynamics. Work and power. Problems with constant force or force with linear variation. Energy. Potential energy. Kinetic energy of translation. Newton's laws of motion. Conservation of momentum. Centrifugal force and its application to conical pendulum, unloaded governor, curved tracks and machine parts. Stress in thin rim due to centrifugal action.

Machines. Simple lifting machine. Graphs of load-effort and load-efficiency. Linear law. Velocity ratio, mechanical advantage and efficiency of the following machines: wheel and axle, differential wheel and axle, rope pulley blocks, differential pulley blocks, screw jack, Warwick screw, hydraulic jack, worm-driven chain blocks and single and double purchase crab winches. Reduction gearing.

Stress and strain. Direct stress and strain. Modulus of elasticity. Shear stress and strain. Modulus of rigidity. Factor of safety. Stress due to restricted expansion or contraction of single members.

Beams. Shearing force and bending moment diagrams for cantilevers and simply supported beams with concentrated or uniformly distributed loads. Stress due to bending.

Torsion. Strength and stiffness of solid or hollow shafts. Stress due to torsion. Power transmitted by shafts and coupling bolts.

Thin shells. Circumferential and longitudinal stress in thin cylindrical shells subject to internal pressure.

Hydrostatics. Equilibrium of floating bodies. Variation of fluid pressure with depth. Total force due to liquid pressure on immersed plane surfaces horizontal or vertical. Centre of pressure on a rectangular vertical plane surface or triangular plane surface, both with one edge parallel to the surface of the liquid.

Hydraulics. Full bore flow of liquid through pipes under constant head. Flow through orifice. Coefficients of velocity, contraction of area and discharge.

Heat Engines

Heat. Temperature and its measurement. Absolute temperature. Specific heat capacity. Specific enthalpy of evaporation and fusion. Problems involving changes of phase and not more than three substances. Linear, superficial and volumetric expansion due to temperature changes. Coefficients and the relationship between them.

Basic thermodynamic principles. Properties, energy, the First Law of Thermodynamics, flow and non-flow processes.

Heat transfer. Qualitative treatment of heat transfer by conduction convection and radiation. Laws of conduction and thermal conductance and applications to problems.

Gases. Boyle's and Charles' laws for perfect gases. Characteristic equation. Constant R and its use in simple problems. Isothermal, adiabatic and polytropic processes. Relationships between pressure, temperature and volume. Work done. Change in internal energy. Specific heat c to the base p and c to the base v and the relationship between them.

Ideal Gas cycles. Constant volume cycle. Diesel cycle. Dual cycle. Air standard efficiency.

I.C. Engines. Elementary principles and cycles of operation. Actual indicator diagrams. Mean effective pressure. Work done, power developed, indicated and brake thermal efficiencies, mechanical efficiency, overall efficiency. Fuel consumption. Heat balance.

Air compressors. Elementary principles and cycles of operation. Calculation of work done. Indicator diagrams.

Properties of steam. Saturated steam, dry, wet. Dryness fraction. Superheated steam. Internal energy. Enthalpy. Specific volume. Steam tables. Throttling. Separating and throttling calorimeters.

Steam plant. Advantages of using steam expansively. Thermal, mechanical and overall efficiencies of prime movers. Boiler efficiency, heat balance for engine and boiler trials. Change in dissolved solids in boilers and evaporators due to contaminated feed and effect of blowing down. Elementary principles of steam turbines including simple velocity diagrams for impulse and reaction turbines. Force and work done on blades.

Combustion. Solid and liquid fuels. Calorific value. Chemical equations for complete combustion. Theoretical minimum air required. Excess air.

Refrigeration. Vapour-compression cycle. Refrigerating effect. Cooling load. Use of tables of properties of refrigerants. Coefficient of performance.

Mathematics

Arithmetic. Ratio and proportion. Variation, direct and inverse.

Algebra. Indices, including fractional and negative types. Use of common logarithms for multiplication, division, powers and roots. Use of Naperian logarithms. Simplification of algebraic expressions. Addition, subtraction, multiplication and division of algebraic functions. Re-arrangement of formulae. Factorisation. Algebraic fractions. Squares and cubes of polynomials such as $(a \pm b)^2$ and $(a \pm b)^3$. Simple equations. Quadratic equations and solution by factorisation, or use of general formula for solution. Simultaneous equations.

Graphical work. The graph $y=ax+b$ either from calculated values or from experimental results. Calculation of constants from graphs. Graphical solution of simple simultaneous equations involving two unknowns. Graph of $y=ax^2+bx+c$ and graphical solution of equation $ax^2+bx+c=0$.

Trigonometry. Measurement of angles in degrees and radians. Complementary and supplementary angles. Sine, cosine and tangent of angles up to 360°. Sine and cosine rules and their application to the solution of triangles. Solution of simple trigonometric equations. Expansion of sin $(A \pm B)$ and cos $(A \pm B)$. Graphs of sin θ, cos θ and a sin $\theta + b$ cos θ.

Geometry. Properties of triangles. Theorem of Pythagoras. Sum of the angles. Relation between exterior and interior angles. Isosceles and equilateral triangles. Similar and congruent triangles.

The circle. Properties of chords and tangents. Angles in the same segment. Angles at centre and circumference.

Mensuration. Areas of triangle, polygon, parallelogram, trapezium, circle, sector and segment of a circle and ellipse. Area and mean height by mid-ordinate rule and by Simpson's rules. Ratio of areas of similar figures. Volumes and surface areas of prisms, pyramids, frustums, spheres, cylinders and cones. Ratio of masses, and volumes of similar solids. Solids of revolution.

Calculus. Tangent to a curve; meaning of differential coefficient. Differential coefficient of x^n, sin x, cos x, tan x, e^x, log to the base e x. Simple examples of the differential coefficient of a product, quotient and function of a function. Application to maximum and minimum values.

Integration as a reverse of differentiation. Integrals of x^n, x *one over* x, e^{ax}, sin ax, cos ax, $\sin^2 qx$, $\cos^2 ax$. Definite integral as the limit of a sum. Areas under curves, volumes of solids of revolution, work done, mean and *rms* values, centroids and second moment of area.

Engineering Drawing

The Drawing paper will consist of a test of the ability to apply the principles of projection and candidates will be asked to draw a plan, elevation or section or a combination of these views of a piece of marine machinery from information supplied. All the required information for the completion of the drawing will be given in the question paper.

Electrotechnology

The electric circuit. Units — ampere, ohm, volt. Difference between electromotive force and potential difference. Ohm's Law. Kirchoff's Laws. Simple series and parallel circuits involving e.m.f., current and resistances. Non-linear resistors in parallel with constant value resistors. Power and energy. Specific resistance. Temperature coefficient of resistance. Conductor resistance, effect of length, area, material and temperature. d.c. 2-wire distribution system. Types of insulation. Wheatstone network bridge, slide wire bridge; applications to steering gears, resistance pyrometers, strain gauges etc.

Electrolytic action and secondary cells. Theory of electrolytic dissociation applied to common solutions. Uses of electrolysis. Secondary cells(acid or alkaline). Construction and principles. Maintenance, charging. Watt-hour and ampere-hour efficiencies.

Electromagnetism, electromagnetic induction, simple magnetic circuit. Simple magnetic theory. Magnetic field. Lines of force. Field strength. Field intensity. Magnetic fields due to current in straight conductors, loops, coils and solenoids. Relative directions of current and field. Faraday's and Lenz's Laws. Magnitude and direction of induced e.m.f. Force produced on a current carrying conductor. Flux density. Effect of iron. Magneto motive-force (m.m.f.). Permeability. Reluctance. Simple magnetic circuit, typical B/H and u/B curves.

Electronics. Qualitative treatment of: Atomic structure and bonding. Semi-conductors. Junction diodes, junction transistors and their operating characteristics. Simple transistor circuits. Conduction in gases, insulators, semi-conductors and conductors. Photo-electric effect.

Alternating current theory. Simple continuous periodic waves: frequency, amplitude, instantaneous, maximum, r.m.s. and average values, form factor. Phasor representation of a.c. quantities. Phase difference. The inductor. Inductance and its effect on the circuit. The capacitor. Capacitance and its effect on the circuit. Simple series and parallel circuits. Relationship between resistance, reactance and impedance. Simple treatment of power factor. Power in single phase a.c. circuit.

Instruments. Qualitative treatment of the principles and functions of a.c. and d.c. indicating instruments and relays. Uses of shunts and series resistances to increase the range. Rectifiers and transducers.

Distribution systems. Systems for a.c. and d.c. shipboard installations. Protective devices such as fuses, circuit breakers, earth lamps. Cable material and installation. Connection of shore supply.

d.c. machines. The principles, constructional details and protection of d.c. series, shunt and compound wound motors and generators. Self-excitation, e.m.f. and load voltage equations. Load characteristics. Methods of voltage control, paralleling procedures and load sharing for generators. Need for and types of starter, speed and torque equations, speed control of d.c. motors.

a.c. machines. Simple explanation of the principles, constructional details and protection of alternators, squirrel-cage induction motors and single-phase transformers. Parallel running and synchronising theory.

Naval Architecture

General. Displacement. Wetted surface. Block, mid-section, prismatic and water-plane area coefficient. Tonne per centimetre immersion. Application of Simpson's Rules to areas, moment of area, volumes and moment of volume.

Draught and buoyancy. Alteration of mean draught due to change in density of water. Buoyancy and reserve buoyancy. Effect of bilging amidship compartments.

Transverse stability. Centre of gravity. Centre of buoyancy. Metacentre. Shift of centre of gravity due to addition or removal of mass, transverse movement of mass, suspended mass. Stability at small angles of heel (given the second moment of area of the waterplane or formulae). The inclining experiment.

Resistance and propulsion. Comparison of skin frictional resistance of hull with model at different speeds. R to the base $f = f.S.v.^n$ and residual resistance. Admiralty and fuel coefficients. Relation between speed of vessel and fuel consumption with constant displacement and assuming that resistance varies as (speed)^n. Elementary treatment of propeller and simple problems on pitch, pitch ratio, apparent slip, real slip, wake, thrust and power.

Structural strength. Simple problems on strength of structural members to resist liquid pressure. Loading due to head of liquid.

Ship construction. Common terms used in the measurement of steel ships, eg length between perpendiculars, breadth overall, moulded depth, draught and freeboard. Definitions of shipbuilding terms in general use. Descriptions and sketches of structural members in ordinary types of steel ships. Watertight doors. Hatches. Rudders. Bow thrusters. Propellers. Watertight bulkheads. Double bottoms. Anchors and cables. Descriptive treatment of the effect of free surface of liquids on stability. Arrangements for the carriage of dangerous goods in bulk.

Ventilation arrangements (natural and mechanical) for pump rooms in tankers and for holds and oil fuel tanks.

Fore and aft peak tanks, double bottom and deep tank filling and pumping arrangements. Compartmental drainage. Levelling arrangements for damaged side compartments.

Engineering Knowledge

Notes:

(i) The engineering knowledge to be shown by candidates is that which is is required for the use, operation and maintenance of the machinery, equipment and ship structure usually in the charge of the engineer officer. A knowledge of the managerial responsibilities of a certificated engineer officer and a knowledge of training, organisation and procedures will be required.

Candidates should possess, a knowledge of International Maritime Law embodied in international agreements and conventions as they effect the specific obligations and responsibilities of the engine department particularly those concerning safety and the protection of the marine environment, and also a knowledge of Maltese Maritime Legislation including arrangements for implementing international agreements and conventions.

(ii) Candidates may be required to illustrate their answers by means of freehand sketches.

(iii) The viva voce examination will include questions on the management of engines and boilers, electrical machinery, prevention of fire and methods of fighting fires at sea, the duties of the supervising engineer officer, the work to be done to engines, boilers and auxiliary machinery in port and the periodical examination of the working parts. Candidates should also be well acquainted with machinery and boiler casualties which may occur at sea and be able to state how these may be prevented and remedied.

(a) Properties and characteristics of metals, material, liquids, gases and vapours used in machinery on board ship.

(b) Processes to which the component parts of machinery are submitted or which are incidental to their manufacture.

(c) Maintenance of machinery. Method of dealing with wear and tear of machinery, both electrical and mechanical, and boilers. Alignment of machinery components. Correction of defects. Temporary or permanent repairs in the event of breakdown.

(d) Construction details, and where applicable the manner of attachment to ship, principles involved and operation of:

(1) water gauge, thermometer, salinometer, ammeter, wattmeter, pressure gauge and other meters and gauges commonly used by engineers on board ship.

(2) pumps, pumping systems, oily water separators.

(3) thrust blocks, shafting, bearings, stern tubes, propellers, ship side fittings.

(4) steering gear, stabilizers.

(5) refrigeration machinery, deck machinery.

(6) auxiliary boilers and steam plant.

(7) (i) compression ignition engines, gearing, clutches, air compressors,

(ii) auxiliary compression ignition engines and associated plant.

(e) Safe working practices, overhauling machinery, mechanical safety in workshops, protective equipment, lifting tackle, entering tanks.

(f) (1) Precautions against fire or explosion. Explosive mixtures. Danger of oil leakages. Sources of ignition. Safety devices.

(2) Toxic and other dangerous properties of substances used in marine practice. Maintenance of plant associated with the carriage of dangerous goods.

(3) Fire prevention, detection, extinction. Principle of operation, application and maintenance of fire extinguishers, respirators, safety lamps. Fixed fire detection and extinguishing arrangements for accommodation, cargo and machinery spaces.

(g) Control systems, automation and instrumentation. Periodically unattended machinery, techniques and work practices. Bridge control.

(h) Safe and efficient operation of compression ignition engines. Application of the indicator. Interpretation of normal card.

(i) Safe and efficient operation of electrical machines and systems.

(j) General requirements concerning fuel oil systems.

(k) General requirements concerning lubricating oil systems.

(l) General requirements concerning bilge, ballast fire pumping systems.

(m) Regulations regarding the prevention of pollution of the marine environment. Effects of marine pollution on the environment.

FIRST ENGINEER

Applied Mechanics

Statics. Equilibrium of non coplanar forces. Rapson's slide.

Friction. Friction clutches. Friction on inclined plane. Friction on threads. Work done against friction.

Kinematics. Linear and angular motion with acceleration. Cams. Velocity-time and acceleration-time graphs.

Dynamics. Acceleration of connected bodies. Effect of simple air resistance on motion under the effect of gravity. The torque equation. Kinetic energy of translation and of rotation. Flywheels. Impulsive forces. Governors including sleeve friction. Simple harmonic motion. Simple pendulum. Simple vibrations. Dynamic balancing of masses rotating in one plane. Basic dynamics of the engine mechanism.

Stress and strain. Stresses on oblique planes. Complementary shear stress. Strength of simple connections such as cottered or screwed joints. Resilience due to direct stress. Suddenly applied loads. Effect of direct loading and of temperature changes on compound members.

Beams. Neutral axis of beams of simple section. Use of deflection formulae.

Torsion. Torsion of shaft fitted with liner. Close coiled helical spring.

Struts. Eccentric loading of short columns. Use of strut formulae.

Hydrostatics. Flotation in two liquids of different densities. Total force and centre of pressure on immersed surfaces such as bulkheads.

Hydraulics. Bernoulli's equation and applications. Venturi meter. Force exerted by a jet. Blade angle diagrams for a centrifugal pump.

Control. Simple flow and control problems.

Heat Engines

Basic thermodynamic principles. Second Law of Thermodynamics and applications.

Heat transfer. Use of log mean temperature difference. Radiation, Stefan-Boltzmann Law.

Gases. Avagadro's hypothesis. Universal gas constant. Dalton's law of partial pressures and application to mixtures of gases and vapours such as the effect of air leakage into condensers.

Determination of n from graph connecting p and V. Proof of the formula c to the base p $-$ c to the base v $=$ R.

Gas cycles. Use of entropy charts. Open and closed cycles for gas turbines. Carnot and reversed Carnot cycles.

Properties of steam. Use of steam tables to deal with changes of entropy.

Steam plant. Basic Rankine cycle. Isentropic efficiency. Enthalpy drop in turbines. Flow through nozzles excluding proof of critical pressure ratio. Effect on thermal efficiency of such modifications as superheating, reheating and regenerative feed heating. Use of enthalpy-entropy charts to determine steam condition at various stages.

Basic calculations on evaporator and boiler performance.

Combustion. Basic analysis of exhaust gases. Relation between volumetric and mass analysis of a gas mixture. Carbon dioxide content of exhaust gases.

Electrotechnology

The electric circuit. The Superposition and Thevenin's Theorems in network problems. Circuits involving non-linear elements.

Electromagnetic induction, magnetic circuit. Mutual inductance. Energy stored in an electric field. Treatment of voltage and current charges in an electric circuit involving inductance and resistance. Time constants, B/H and B/Ampere turns per metre curves and their effect on simple magnetic circuits involving an air gap. Qualitative treatment of hysteresis.

Electrostatics. Types of capacitor. Simple series and parallel circuits involving capacitors. Electric force and electric flux density, relatve permittivity, charging and discharging currents of a capacitor connected in series with a resistor across a d.c. supply. Energy stored in a capacitor. Generation of static-electricity.

Electronics. The characteristics of junction transistors. The effect of voltage feedback on amplifier gain, input and output impedances. Equivalent circuits. Rectification. Simple treatment of thyristors and zener diodes.

Alternating current theory for 3 phase systems. Current and voltage relationships. Current, voltage, power and power factor applied to *RLC* circuits. The impedance triangle. Power factor improvement. Resonance. Star and delta systems.

d.c. machines. Armature reaction. Speed control. Efficiency. Application to a Ward Leonard system. Suitability of d.c. motors for the various types of work. Motor starters; automatic types. Calculations on starters.

a.c. machines. The principles, constructional details and protection of salient pole, cylindrical and brushless alternators. The e.m.f. equation and automatic voltage regulation for an alternator.

The production of rotating magnetic fields. Relation between frequency, number of poles and speed of a machine.

The principes, constructional details and protection of induction motors. Slip, rotor e.m.f. and frequency. Torque-speed curves. Wound, slip ring, cage and double wound types. Starting methods.

The principles and constructional details of single-phase transformers. The e.m.f. equation and efficiency. Auto-transformers and current transformers.

Naval Architecture

General. Wetted surface formulae. Simpson's rules applied to second moments of areas, volumes, centroids and centres of pressure. Shearing force and bending moment of loaded ship in still water.

Transverse stability. Moment of statical stability. GZ curves. Cross curves of stability. Hydrostatic curves commonly supplied to ship. Effect of free liquid surface and subdivision of tanks. Dangers due to water accumulation during fire-fighting. Practical requirements to ensure stability at sea. Management of water and fuel tanks. Filling and emptying tanks at sea. Longitudinal stability. Longitudinal BM and GM and statical stability. Centre of flotation and its calculation. Moment to change trim by one centimetre.

Draught, trim and heel. Changes due to adding or removing fuel, ballast or cargo. Changes due to alteration in density of sea water. Changes due to bilging of compartments, using the lost buoyancy and added mass methods. Forces on rudder and stress in rudder stock. Heel when turning, including effect of centrifugal force and of force on rudder.

Resistance and propulsion. Derivation of Admiralty and fuel coeifficients. The law of corresponding speeds. Froude's law of comparison. Simple problems on the prediction of full-scale resistance from model experiments. Problems on propellers involving the use of wake factor, ep, dp, QPC, thrust and power. Qualitative treatment of cavitation.

Ship construction. Forces on ship under various conditions, including the effect of panting and pounding. Construction of all parts of steel ships. Use of high tensile steel and aluminium. Structural fire protection arrangements. Dry docking. Design features of ships for general and specialised trades.

Ship measurement and classification. Meaning of 'classed' and 'unclassed' ships. Common terms used in measurement of modern steel ships. Common terms used in tonnage measurements, eg gross tonnage, net tonnage, propelling power allowance.

Load Line. Common terms, markings and main criteria used in assignment of freeboards. Maintenance of conditions of assignment.

Life saving equipment. Operation and handling gear for lifeboats and liferafts.

Engineering Knowledge

Notes:

(i) The engineering knowledge to be shown by candidates is that which is required for the use, operation and maintenance of the machinery, equipment and ship structure usually in the charge of the engineer officer. A knowledge of the managerial responsibilities of a certificated engineer officer and a knowledge of training, organisation and procedures will be required.

Candidates should possess a knowledge of International Maritime Law embodied in international agreements and conventions as they effect the specific obligations and responsibilities of the engine department particularly those concerning safety and the protection of the marine environment, and also a knowledge of Maltese Maritime legislation including arrangements for implementing international agreements and conventions.

(ii) Candidates may be required to illustrate their answers by means of freehand sketches.

(iii) The viva voce examination will include questions on the management of engines and boilers, electrical machinery, prevention of fire and methods of fighting fires at sea, the duties of the supervising engineer, the work to be done to engines, boilers and auxiliary machinery in port and the periodical examination of the working parts.

Candidates should also be well acquainted with machinery and boiler casualties which may occur at sea and be able to state how these may be prevented and remedied.

(a) Properties and characteristics of metals, materials, liquids, gases and vapours used in machinery on board ship.

(b) Processes to which the component parts of machinery are submitted or which are incidental to their manufacture.

Maintenance of machinery.

Method of dealing with wear and tear of machinery, both electrical and mechanical, and boilers. Alignment of machinery components. Correction of defects. Temporary or permanent repairs in the event of breakdown.

(d) Constructional

Principles involved with operation of:

(1) pumps, pumping systems, oily water separators.

(2) thrust blocks, shafting, bearings, stern tubes, propellers, ship side fittings.

(3) steering gears, stabilizers.

(4) refrigeration machines, deck machinery.

(5) auxiliary boilers and associated steam plant.

(6) (i) compression ignition engines, gearing, clutches, air compressors.

(ii) auxiliary compression ignition engines and associated equipment.

(7) turbo-electric, diesel electric, gas turbine drives.

(e) Safe working practices, overhauling machinery, mechanical safety in workshops, protective equipment, lifting tackle, entering tanks.

(f) (1) Precautions against fire or explosion. Explosive mixtures. Danger of oil leakages. Sources of ignition. Safety devices.

(2) Toxic and other dangerous properties of substances used in marine practice. Maintenance of plant associated with the carriage of dangerous goods.

(3) Fire prevention, detection, extinction. Principle of operation, application and maintenance of fire extinguishers, respirators, safety lamps. Fixed fire detection and extinguishing arrangements for accommodation, cargo and machinery spaces.

(g) Control systems, automation and instrumentation. Periodically unattended machinery, techniques and work practices. Bridge control.

(h) Safe and efficient operation of compression ignition engines. The determination of shaft power and recognition of irregularity in the performance of the machinery and plant.

Analysis and interpretation of information gained from monitoring equipment.

(i) Safe and efficient operation of electrical machines and systems.

(j) General requirements concerning fuel oil systems.

(k) General requirements concerning lubricating oil systems.

(l) Knowledge of the appropriate statutes of concern to marine engineer officers. The administrative duties of a Chief Engineer, i.e. the organisation and training of staff for both normal and emergency duties including the use of safety equipment, and the organisation of repairs and surveys and associated reports.

(m) Regulations regarding the prevention of pollution of the marine environment. Effects of marine pollution on the environment.

Ippubblikat mit-Taqsima tat-Tagħrif — Kastilja — *Published by the Information Division — Kastilja*

Mitbugħ fl-Istamperija tal-Gvern — *Printed at the Government Printing Press*

Prezz 6c — *Price 6c*