CERTIFICATE OF COMPETENCY EXAMINATION

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY

MANAGEMENT ENGINEER (UNLIMITED)

040-12 - ENGINEERING KNOWLEDGE - GENERAL

MONDAY, 15 July 2024

0915-1215 hrs

Examination paper inserts:

Notes for the guidance of candidates:

Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass **AND** also obtain a minimum 40% in Sections A, B and C of the paper.

Materials to be supplied by examination centres:

Candidate's examination workbook

ENGINEERING KNOWLEDGE - GENERAL

Attempt TEN questions only as follows:
SIX questions from section A
TWO questions from section B
TWO questions from section C
Marks for each part question are shown in brackets

Section A

1. (a) Describe the properties of EACH of the following alloys used in marine engineering, giving a practical example for which EACH are suited:

(i) cupro-nickel; (2)

(ii) white metal; (2)

(iii) titanium; (2)

(b) Apart from corrosion and erosion resistance, describe the properties of EACH of the following for use in the munufacture of large propellers;

(i) nickel aluminium bronze (2)

(ii) stainless steel. (2)

2. With reference to pneumatically operated control valves:

(a) state the reasons for fitting valve positioners; (4)

(b) with the aid of a sketch, explain valve hysteresis and how it affects the process; (4)

(c) describe how the design and routine maintenance can limit hysteresis. (2)

3. With reference to propeller shaft support bearings:

(a) describe, with the aid of a sketch, the operation of a tilting pad shaft bearing, indicating how the oil pressure is distributed; (5)

(b) explain why this type of bearing evolved, stating its advantages over plain bearings. (5)

4. With reference to multi-tubular heat exchangers, explain how EACH of the following contribute to satisfactory performance:

(a) tube wall thickness; (2)

(b) dense population of tubes in the tube plate; (2)

(c) tube materials selection; (2)

(d) coolant flow rates; (2)

(e) unimpeded passage of coolant at entry and exit from the tubes. (2)

5. With reference to centrifugal pumps and pumping systems:

(a) explain, with the aid of a diagram, the distinction between Net Positive Suction Head available (NPSHa) and Net Positive Suction Head required (NPSHr); (8)

(b) explain how the NPSHa may be increased by design. (2)

6. With reference to a keyless propeller designed for hydraulic (wet) fit and withdrawal:

(a) describe, with the aid of a sketch, how the propeller is fitted to the tail shaft; (6)

(b) state TWO advantages compared to a dry fit; (2)

(c) explain how the thrust is transmitted without the use of a key and keyway. (2)

7. With reference to air compressors for general service use:

(a) explain the principle of operation of a screw type compressor; (4)

(b) explain the advantages of screw compressors over reciprocating compressors in terms of running and maintenance. (6)

8. Describe the inspections and tests that should be carried out to ensure satisfactory condition and operation of the ship's fire fighting equipment. (10)

Section B

9. With reference to the paralleling of a.c. generators:

(a) outline the requirements for synchronisation; (3)

(b) explain how KW power is shared; (2)

(c) explain how Kvar power is shared; (1)

(d) state FOUR types of damage that may be caused when machines are incorrectly synchronised. (4)

10. Describe, with the aid of a circuit diagram, a synchro-converter for the variable speed control of a.c. motors. (10)

11. (a) State FIVE essential electrical services that are able to be operable under fire conditions. (5)

(b) Explain how electric cables for the essential services in part (a) pass through bulkheads whilst maintaining gas tight and water tight integrity. (3)

(c) State the requirements for the cables which supply electrically driven emergency fire pumps. (2)

Section C

12. With reference to ship construction:

(a) explain why conventional liquid carriers are divided by longitudinal bulkheads; (2)

(b) explain why ore carriers may be fitted with wing tanks; (2)

(c) state, other than the carriage of liquids, the purposes of double bottom tanks in dry cargo ships; (2)

(d) state FOUR reasons for transverse watertight bulkheads in ship construction. (4)

13. (a) Explain why a single propeller and single rudder may not be suitable for large cargo vessels having a wide beam. (3)

(b) Explain the advantages of a twin propeller twin rudder installation in vessels with a large cargo carrying capacity. (7)

14. Explain, with the aid of a mid-ship half sectional sketch of a container ship, how strength is built into this type of vessel whilst still allowing access to the cargo holds. (10)