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, 11 December 2023

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) Sketch a Stress/Strain curve for a mild steel test specimen. (2)

   (b) With reference to the curve sketched in part (a), explain EACH of the following:

   (i) modulus of elasticity; (2)

   (ii) percentage elongation; (2)

   (iii) ultimate tensile stress; (2)

   (iv) yield stress. (2)

2. Discuss the advantages and disadvantages of electrical remote monitoring and control systems compared to pneumatic systems. (10)

3. With reference to main propulsion shaft systems:

   (a) describe a method of hydraulic jacking to check bearing loads; (5)

   (b) sketch the Bearing Load versus Shaft Lift Dial Gauge Reading graph obtained by the method described in part (a), annotating the graph and how the characteristic of bearing load is obtained. (5)

4. With reference to plate type heat exchangers:

   (a) sketch a cross sectional view showing the plate design pattern and the directions of hot and cold fluid flow; (4)

   (b) state TWO reasons for the plate design patterns; (2)

   (c) state, with reasons, FOUR advantages of a plate cooler compared to shell and tube type. (4)

5. With reference to centrifugal pumps:

(a) describe how EACH of the following improves pump performance:

(i) raising the speed of rotation; (2)

(ii) multi-staging. (2)

(b) explain the advantages of using centrifugal pumps instead of positive displacement pumps for lubricating oil circulating duties. (6)

6. (a) State the regulations pertaining to the main and auxiliary steering gear with reference to EACH of the following:

(i) rudder angle and time of operation; (2)

(ii) electrical supply. (3)

(b) With reference to a hydraulic steering gear, explain EACH of the following:

(i) the factors that may contribute to the failure of a hydraulic pipe coupling; (2)

(ii) what is meant by the single failure concept. (3)

7. In a vapour compression refrigeration system, state how EACH of the following faults are indicated and how they are remedied:

(a) air in the refrigerant; (2)

(b) oil in the refrigerant; (2)

(c) moisture in the refrigerant; (2)

(d) undercharge of the refrigerant; (2)

(e) overcharge of the refrigerant. (2)

8. As Chief Engineer Officer, prepare standing orders for working with gas cutting and gas welding equipment, including the storage of spare bottles. (10)

Section B

9. (a) Sketch a circuit showing how the emergency generator is started, connected to the emergency busbars and how the main busbars are disconnected in the event of a blackout. (6)

(b) Explain how an emergency generator can be tested to ensure that it is capable of satisfactorily delivering the rated power. (4)

10. With reference to braking of a.c. induction motors:

(a) explain why braking may be required; (2)

(b) explain why electrical braking is preferable to mechanical braking; (2)

(c) explain the term *plugging*; (2)

(d) describe how dynamic braking is achieved. (4)

11. With reference to the protection of electrical power circuits:

(a) explain *discrimination*, describing how it is achieved. (5)

(b) state, with reasons, the type of fuses used for protection; (3)

(c) explain *preferential tripping*. (2)

Section C

12. (a) Describe the SIX degrees of motion that a ship at sea moves in when encountering heavy weather. (6)

(b) Describe the constructional details that are designed to resist the forces exerted on a ship by the motions described in part (a). (4)

13. (a) Explain the system of classification for access doors passing through watertight bulkheads of a vessel. (3)

(b) State THREE circumstances under which all watertight doors must be closed when situations are defined as potentially hazardous. (3)

(c) As a Senior Engineer Officer, explain to a new crew member how to pass safely through a hydraulically operated watertight door (4)

14. With reference to the overhaul of ship side valves in dry dock:

(a) explain, as Chief Engineer Officer, what essential information should be given to the docking company prior to work commencing; (5)

(b) describe how the valves would be overhauled stating the precautions to be taken before returning the ship to service. (5)