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, 16 October 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. Describe EACH of the following properties of materials:

   (a) strength; (2)

   (b) hardness; (2)

   (c) ductility; (2)

   (d) toughness; (2)

   (e) brittleness. (2)

2. (a) Explain EACH of the following control terms:

      (i) proportional action; (2)

      (ii) integral action. (2)

   (b) Describe, with the aid of a sketch, a control system that may be enhanced by the inclusion of cascade control. (6)

3. With reference to main thrust block arrangements:

   (a) explain how the tilting pads assist in the formation of an oil wedge; (2)

   (b) describe the actions that may be taken if upon inspection the pads are found to be:

      (i) lightly scored; (2)

      (ii) wiped; (2)

   (c) explain how the thrust clearance may be measured, stating a typical value; (2)

   (d) state the possible effects if the thrust clearance is incorrect. (2)

4. With reference to centrifugal pumps:

(a) explain the operating principle of a centrifugal pump, stating why it is unnecessary to fit a relief valve to it; (3)

(b) explain why some pumps have a double entry impeller; (2)

(c) describe a routine overhaul of a centrifugal pump, stating the inspections, measurements and possible replacement parts that may be required. (5)

5. State the inspections, instructions and maintenance that should be carried out on main sea water pipelines, strainers and ship's side valves to minimise the risks of engine room flooding. (10)

6. (a) Sketch a diagrammatic arrangement of a fully automatic direct expansion domestic refrigeration system. (5)

(b) Explain the operation of the Low Pressure switch. (2)

(c) State, with reasons, THREE possible faults that could cause the High Pressure switch to operate. (3)

7. (a) State the possible causes for EACH of the following auxiliary diesel engine lubricating oil sample results:

(i) high acidity; (2)

(ii) high sediment content; (2)

(iii) excessive water content; (2)

(iv) fuel dilution. (2)

(b) Explain which of the results in part (a) would give greatest concern. (2)

8. With reference to a major fire in the machinery space:

(a) explain why EACH of the following equipment is shut down remotely, stating how it is achieved;

(i) settling and service tank outlet valves; (2)

(ii) fuel transfer and supply pumps; (2)

(iii) mechanical and natural ventilation; (2)

(b) explain how the fire is brought under control using the facilities outwith the affected machinery space. (4)

Section B

9. With reference to reverse power protection for a.c. generators operating in parallel:

(a) explain why traditional reverse power relays, operating on mechanical principles, have been replaced by electronic digital microprocessor types; (2)

(b) describe, with the aid of a sketch, a generator reverse power protection circuit that uses an electronic phase sensitive detector. (8)

10. With reference to voltage variation profiles caused by load changes imposed on alternating current generators when starting large motors on line:

(a) sketch a voltage dip, showing an acceptable recovery time; (2)

(b) state FOUR salient factors that cause the variation in part (a); (4)

(c) outline FOUR salient factors that assist recovery from the deviation shown in part (a). (4)

11. With reference to large electrical transformers on board ships:

(a) state where these transformers may be used; (1)

(b) state a typical efficiency range for a transformer; (1)

(c) state the regulations pertaining to transformers; (3)

(d) state the protective devices that are fitted; (2)

(e) describe the maintenance requirements. (3)

Section C

12. (a) Explain the function and location of EACH of the following:

(i) watertight doors; (3)

(ii) weathertight doors. (3)

(b) Explain why a bilge injection valve is incorporated into the main sea water system, describing how it is tested. (4)

13. With reference to ship construction, explain the purpose of EACH of the following, stating where EACH are located:

(a) duct keel; (2)

(b) bilge keel; (2)

(c) collision bulkhead; (2)

(d) camber; (2)

(e) flare. (2)

14. With reference to drydocking a vessel:

(a) state the essential pre-docking information that should be given to the drydock authority; (5)

(b) describe the hull inspection and maintenance that may be carried out in drydock. (5)