2505/205
MARINE MECHANICAL TECHNOLOGY I
Oct./Nov. 2016
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN MARINE ENGINEERING MARINE

MODULE II

MARINE MECHANICAL TECHNOLOGY I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Thermodynamic and Transport properties of fluid tables by Rogers and Mayhew;
Scientific calculator;
Answer booklet.
*This paper consists of **THREE** sections; **A**, **B** and **C**.*
*Answer **THREE** questions in section **A**, **ONE** question in Section **B** and **ONE** question in section **C** to make a total of **FIVE** questions.*
Maximum marks for each part of a question are as shown.
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: GENERAL KNOWLEDGE

*Answer **THREE** questions from this section.*

1. (a) (i) List the **three** categories of fuels used in marine vessels.

(ii) Describe each of the following processes as applied in petroleum distillation:

(I) catalytic cracking;
(II) alkylation;
(III) polymerisation.

(8 marks)

(b) With the aid of sketches, explain each of the following field treatment methods:

(i) separation;
(ii) clarification.

(7 marks)

(c) Environmental protection from ship engine emissions must be reinforced by use of information contained in the technical file of a ship. Outline **five** type of information contained in the technical file. (5 marks)

2. (a) (i) List **two** types of pumps under each of the following classes:

(I) positive displacement;
(II) non-displacement.

(ii) With the aid of a sectional diagram, describe the operation of a rotary vane pump.

(iii) State **three** causes and **three** remedies of air pump leaks.

(11 marks)

(b) (i) Differentiate between isolating and non-return valves.

(ii) Draw and label a non-return spring loaded check valve.

(5 marks)

(c) (i) Explain the main function of a bilge system in a marine vessel.

(ii) Outline **four** requirements of bigle pipings.

(4 marks)

3. (a) (i) Define each of the following terms as used in lubrication:

(I) scuffing;
(II) oxidation;
(III) foaming.

(ii) List **three** functions of a lubricant. (6 marks)

(b) (i) With the aid of sketches, explain each of the following lubrication methods:

(I) boundary;
(II) hydrodynamic.

(ii) Explain the function of each of the following lubricating oil additives:

(I) anti-oxidants;
(II) detergent.

(8 marks)

(c) Describe each of the following shipboard lubricating oil tests:

(i) alkalinity;
(ii) viscousity;
(iii) crackle.

(6 marks)

4. (a) State **two** advantages and **two** disadvantages for each of the following types of stern tubes:

(i) water lubricated;
(ii) oil lubricated.

(4 marks)

(b) Illustrate an oil lubricated stern tube system. (5 marks)

(c) With the aid of a sketch, describe the procedure of stern tube alignment by optical telescope method on a dry dock. (11 marks)

5. (a) With the aid of a labelled diagram, explain the operation of a double effect forward feed evaporator. (6 marks)

(b) (i) State **four** precautions to be observed when starting a marine evaporator.

(ii) Describe the procedure of starting a marine vessel.

(10 marks)

(c) Outline **two** measures taken to prevent solid deposition in the evaporator tubes.

(4 marks)

SECTION B: THERMO FLUIDS

*Answer **ONE** question from this section.*

6. (a) Define each of the following terms as applied to steam:

(i) specific enthalpy;
(ii) specific entropy;
(iii) dryness fraction.

(3 marks)

(b) Derive the expression for work done in a polytropic expansion process. (8 marks)

(c) The pressure of steam used to operate a turbine is 7.5 bar and a dryness fraction of 0.85 at the beginning of an expansion process. At the end of the process the pressure drops to 0.35 bars. If the law of the expansion process is $pv^{1.1} = c$, determine the power output for a steam flow rate of 8.6 kg/s. (9 marks)

7. (a) Define each of the following terms as applied to fluid pressure:

(i) resultant force;
(ii) centre of pressure.

(2 marks)

(b) A plane surface of area A is inclined at an angle Φ to the horizontal of a liquid of specific weight W. The centroid of the body is at a vertical depth Y below the free surface. Derive the expression for the vertical depth D at which the resultant force R acts on the body. (12 marks)

(c) A circular sluice gate of 1.40 m diameter is immersed in water at 60° to the horizontal, so that the upper tip and lower tip are 750 mm and 1,850 mm respectively when measured vertically from the free surface of water. Determine the:

(i) total force acting on one side of the gate;
(ii) vertical distance of the centre of pressure below the free water surface.

(6 marks)

SECTION C: APPLIED MECHANICS

*Answer **ONE** question from this section.*

8. (a) (i) Define each of the following terms:

(I) dynamic friction;
(II) static fraction;
(III) limiting friction.

(ii) State **four** laws of dry friction. (5 marks)

(b) An effort of 1,500 N acting parallel to a plane inclined at 12° to the horizontal is required to slide a body up the plane. When the angle of inclination is increased to 15°, the effort required is 1,720 N. Determine the:

(i) weight of the body;
(ii) coefficient of friction.

(9 marks)

(c) A single start square thread of 50 mm external diameter with a pitch of 6 mm is used to close a 150 mm diameter valve. If the valve is acted upon by air pressure of 2 MN/m^2 and the screw coefficient of friction is 0.12, calculate the torque required to turn the valve handle. (6 marks)

9. (a) A thin wall cylinder of internal diameter D, plate thickness T and length L, is subjected to an internal pressure P. With the aid of sketches, show that the longitudinal stress $6L$ set up in the cylinder wall is half the hoop stress 6μ.

(13 marks)

(b) A boiler of internal 2.65 m and plate thickness 15 mm carries steam at a pressure of 35 bar. The longitudinal and circumferential joint efficiencies are 80% and 50% respectively. If the ultimate tensile stress of the plate is 1,425 KN/m^3, determine the factor of safety. (7 marks)

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