Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations– June 2024

Programme Name: B Tech (ME)

Semester: Sixth

Subject Code: UG11T4602

Subject Name: MARINE MACHINERY SYSTEMS AND DESIGN

Date: 29.05.2024 Max Marks: 70

Duration: 03 Hrs Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.
(iii) ***Necessary Design data books will be permitted***

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. Thermal strain in a machine component is estimated using below parameters
(a) Young's modulus and stress
(b) Modulus of rigidity and stress
(c) Coefficient of thermal expansion and temperature difference
(d) None of the above

2. The most suitable bearing for carrying heavy loads at slow speed is
(a) Hydrodynamic bearing
(b) Ball bearing
(c) Roller bearing
(d) Hydrostatic bearing

3. The Connecting rod of IC engine is mostly manufactured using which type of manufacturing process
(a) Casting
(b) Forging
(c) Machining
(d) None of the above

4. What is the primary purpose of the emergency fire pump on a ship?

(a) To supply water for routine deck cleaning

(b) To provide water for firefighting in case of emergencies

(c) To supply water for crew showers

(d) To fill the ballast tanks

5. What is the primary function of a thrust block in a marine propulsion system?

(a) To reduce fuel consumption

(b) To increase engine power

(c) To absorb propeller thrust

(d) To improve steering control

6. High pressure CO2 flooding system should be designed to release 85% of total amount of CO2 gas into the protected space within first

(a) 2 hour

(b) 20 minutes

(c) 2 minutes

(d) None of the above

7. Location of centrifugal pump in emergency fire pump system should be such that suction lift in ballast condition should not be more than

(a) 7.5 m

(b) 4.5 m

(c) 6.5 m

(d) 10.5 m

8. What is the purpose of the air receiver tank in an air compressor system?

(a) To store compressed air

(b) To filter the air

(c) To cool the air

(d) To generate electricity

9. Which of the following is a typical power source for emergency fire pumps on ships?

(a) Main engine

(b) Emergency generator

(c) Solar panels

(d) Wind turbines

10. _____ the turning circle, safer the ship

(a) Shorter

(b) Larger

(c) Medium

(d) None of the above

Section B

Five Questions of 02 Marks each

11. What are the advantages of standardization?

12. What are the factors affecting the design of journal bearing design?

13. Describe the basic function of a torsion spring.

14. State the forces acting on the tail shaft in propulsion shafting system of ship.

15. What are safety devices fitted on main air bottle?

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. A helical compression spring, made of circular wire, is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold-drawn steel wire with ultimate tensile strength of 1050 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate (i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) Total number of coils; (v) free length of spring

Use Wahl's stress actor as $K= ((4C-1)/(4C-4)+ 0.615/C)$ where C is spring index.

(10Marks)

17. The torque developed by an engine is given by the following equation:

$T = 14\,250 + 2200 \sin(2\theta) - 1800 \cos(2\theta)$

where T is the torque in N-m and θ is the crank angle from the inner dead centre position. The resisting torque of the machine is constant throughout the work cycle. The coefficient of speed fluctuations is 0.01. The engine speed is 150 rpm. A solid circular steel disk, 50 mm thick, is used as a flywheel. The mass density of steel is 7800 kg/m^3. Calculate the radius of the flywheel disk and draw the turning moment diagram (Torque- θ diagram). (10Marks)

18. A thrust block is fitted on main engine.

a) Calculate thrust shaft diameter (4 Marks)
b) Calculate area of each thrust pad (4 Marks)
c) Calculate outside diameter of thrust pad (2 Marks)

Given: P= 20 MW, N= 120 rpm, Allowable shear Stress= 30MN/m^2. Angle subtended by pads at the centre =45 degree, Velocity of ship= 17.1 knots, Velocity of wake= 5.13 knots, Transmission efficiency= 0.98, Propeller efficiency= 0.65, Total number of pads= 6, Clearance between inner edge of pads and thrust shaft= 20 mm, , Total number of thrust pads $=6$, Allowable pressure on thrust pads $(P_t) = 2.414\ \mathrm{MN/m^2}$

19.(a) Draw the schematic circuit diagram of four ram electro hydraulic steering gear. (8Marks)

(b) According to SOLAS, state any two safety requirements of steering gear? (2 Marks)

20.(a) Draw the schematic circuit diagram of Air starting system of marine diesel engine. (8Marks)

(b) What are class requirements for capacity of air bottle? (2 Marks)

21.(a) Prove that capacity of Emergency fire pump is 25 m^3/hour.

Given, Pressure at nozzle: 2.1 bar, density of sea water 1010 kg/m^3, Nozzle diameter = 12 mm and number of nozzles = 2, Coefficient of discharge= 0.9 (5 Marks)

(b) Calculate fuel tank size for emergency fire pump diesel engine having specific fuel oil consumption = 200 gm/bhp-hr
Given: Engine power: 10 H.P., Density of oil = 0.87 (5Marks)

22. State and briefly explain the important steps in Finite Element Analysis (using any commercial software like ANSYS, ABAQUS etc.) for estimation of stresses and deformation in machine components. (10Marks)