Indian Maritime University

(A Central University, Govt of India)

Mar/Apr'26 SE

Programme Name: B Tech(ME)

Semester: VI

Subject Code: UG11T4602

Subject Name: MARINE MACHINERY SYSTEMS & DESIGN

Date: 16.03.2026	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.

Section A

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

1. 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

2. 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

3. How often should emergency fire pumps on ships be tested?
(a) Once a year
(b) Once every six months
(c) Once every month
(d) Once every week

4. What happens to the angle of twist of a torsion spring when the applied torque is increased?
(a) The angle of twist decreases.
(b) The angle of twist remains constant.

(c) The angle of twist increases.
(d) The angle of twist becomes zero

5. Which organization regulates the design and installation of CO2 fire-fighting systems on ships?
(a) International Maritime Organization (IMO)
(b) United States Coast Guard (USCG)
(c) European Maritime Safety Agency (EMSA)
(d) International Organization for Standardization (ISO)

6. What is the primary purpose of a CO2 flooding system in fire protection?
(a) To cool down the fire
(b) To displace oxygen
(c) To create a barrier against fire spread
(d) To extinguish electrical fires

7. 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

8. What happens if a thrust block fails in a propulsion system?
(a) Increased fuel efficiency
(b) Decreased engine power
(c) Enhanced manoeuvrability
(d) Risk of severe damage to the propulsion system

9. What safety precautions should be followed when working with air compressors on board ships?
(a) Ensure proper ventilation
(b) Use appropriate personal protective equipment
(c) Secure loose clothing and hair
(d) All of the above

10. 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

Section B

Five Questions of 02 Marks each

11. Explain the function of a flywheel in a reciprocating engine system.
12. Describe the basic function of a torsion spring.
13. Define the purpose of a thrust block in a marine propulsion system.
14. Why Chocks are fitted under the thrust block in marine propulsion systems?
15. What are safety devices fitted on main air bottle

Section C

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

16. (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)

(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 (5)

17. Design refrigeration system for low pressure CO_2 system given that heat leakage into reservoir of liquid CO_2 is 1.375 KW.
a) Calculate Running time, capacity of starter panel, capacity of electric motor. (5)
b) Calculate safety valve size fitted on liquid CO_2 storage tank. (5)

Given: Consider $(COP)_r = 3.5$ and Efficiency $\eta_{mech} = 0.85$, running at 85% MCR.
Pressure setting of safety valve is 22 bar.
Temperature of liquid CO_2 at 22 bar is $-15.5°C$.
Pressure of CO_2 when refrigerating unit switched on 20.2 bar.
Specific enthalpy of evaporation of Liquid CO2 at 22 bar is 276.22 kJ/kg.
Specific volume of saturated CO2 vapour at 22 bar is $0.017\ m^3/kg$.
Specific volume of saturated CO2 liquid at 22 bar is $0.00098\ m^3/kg$.

18. A thrust block is fitted on main engine.
a) Calculate thrust shaft diameter (4)
b) Calculate area of each thrust pad (4)
c) Calculate outside diameter of thrust pad (3)

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 $(P_t) = 2.414\ MN/m^2$

19. A torsion spring with a spring constant of 150 Nm/radian is installed in a garage door mechanism. The spring is designed to produce a torque of 300 Nm when twisted to a certain angle. Calculate:
(a) The angle of twist produced by the spring. (5)
(b) If the spring is twisted beyond its design limit, reaching an angle of 1.5 radians, calculate the torque exerted by the spring at this angle. (5)

20. (a) How does CAD software facilitate stress analysis in mechanical components and explain the difference between static and dynamic stress analysis in CAD? (4)
(b) What are the primary factors that influence stress distribution in a mechanical structure and how to interpret stress analysis results obtained from CAD simulations. Discuss the importance of stress concentration analysis in CAD for identifying potential failure points? (6)

21.A helical spring is made from wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 KN/mm^2. Find the axial load which spring can carry and deflection per active turn.

22. Design a piston head or crown of cast iron piston for a single acting four stroke engine for the following data:
Cylinder bore= 100 mm, Stroke: 125 mm, Maximum gas pressure= 5 N/mm^2, Indicated mean effective pressure: 0.75 N/mm^2, Mechanical efficiency: 80%, Fuel consumption: 0.15 kg per brake power per hour, Higher calorific value of fuel: 42000 kJ/kg, Speed= 2000 rpm