

Indian Maritime University
(A Central University, Govt of India)
Supplementary Examinations – March/April 2025
Programme Name: B Tech (ME)
Semester: Sixth
Subject Code: UG11T4602
Subject Name: MARINE MACHINERY SYSTEMS AND DESIGN

Date: 24.04.2025

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. The most suitable bearing for carrying heavy loads at slow speed is
(a) Hydrodynamic bearing (b) Ball bearing (c) Roller bearing (d) Hydrostatic bearing
2.  The symbol shown indicates which type of tolerance in drawing
(a) Position (b) Concentricity (c) Circularity (d) None of the above
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. 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
5. Thrust pads used in ships to take propeller thrust are usually made of which material
(a) Cast iron (b) Steel (c) Stainless steel (d) White metal

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. What are preferred sizes? Mention some examples of preferred sizes.
- 12. What are the advantages of standardization?
- 13. What are the factors affecting the design of journal bearing design?
- 14. State the forces acting on the tail shaft in propulsion shafting system of ship.
- 15. What is viscosity index (VI) and What is desired VI for crankcase oil.

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/mm² and modulus of rigidity of 81370 N/mm². 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 factor as $K = \left(\frac{4C-1}{4C-4} + \frac{0.615}{C} \right)$ where C is spring index.

17. 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)

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/m².

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 / m²

19. (a) Draw the schematic circuit diagram of Ships' high pressure CO₂ flooding system for protection engine machinery space (exclude cargo space protection system).

(b) State requirement of International Code for Fire safety system to protect largest cargo space. (8 + 2 marks)

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

(b) According to SOLAS, state any two safety requirements of steering gear? (8 + 2 marks)

21. 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/mm²,
Indicated mean effective pressure: 0.75 N/mm², Mechanical efficiency: 80%,
Fuel consumption: 0.15 kg per brake power per hour, Higher calorific value of
fuel: 42000 kJ/kg, Speed= 2000 rpm. (10 Marks)

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.

TAM