

**Indian Maritime University**  
**(A Central University, Govt of India)**  
**End Semester Examinations – December 2022**  
**Programme Name: M. Tech (NAOE)**  
**Semester: I**  
**Subject Code: PG11T2102**  
**Subject Name: SHIP THEORY**

Date: 26.12.2022  
Duration: 03 Hrs

Max Marks: 60  
Pass Marks: 30

**Section A:**

10 MCQs of 01 Mark Each = 10 Marks

1. Which of the following is defined as the centre of buoyancy?
  - a. Centre of gravity of the body
  - b. Centroid of the fluid displaced by the body
  - c. Middle point between C. G and Metacentre
  - d. None of these
2. List in a vessel is caused due to
  - a. Shifting of internal weight
  - b. External wind force
  - c. Both A & B
  - d. None of the above
3. Fresh water allowance is
  - a. Volume displacement / (4 . TPC)
  - b. Volume displacement / (4 . WPA)
  - c. Displacement / (4 . TPC)
  - d. Displacement / (4 . WPA)
4. What is the change happens in the value of MCT 1cm when a vessel move from fresh water to sea water.
  - a. Increases
  - b. Decreases
  - c. No change happens
  - d. Decreases by 2.5 %
5. If the magnitude of dimensions of a rectangular wooden block is Length > breadth > height, then for it to float on the water, it should be immersed in what manner?
  - a. It should be immersed vertically such that the length is partially immersed
  - b. It should be immersed horizontally such that the breadth is partially immersed
  - c. It should be immersed such that height is partially immersed
  - d. None of the mentioned
6. When Docking a ship, the righting moment acting on the ship at very small heel is given by
  - a.  $\left(GM - \frac{w}{W} KM\right) w \sin \theta$
  - b.  $\left(\frac{w}{W} KM - GM\right) w \sin \theta$
  - c.  $\left(\sin \theta - \frac{w}{W} KM\right) wGM$
  - d. None of the above

7. \_\_\_\_\_ is useful in deciding the subdivision of ships.
- Resistance calculation
  - Floodable length calculation
  - Bonjean Calculation
  - Hydrostatics calculation
8. During end launching from a slipway, a situation can arise when the moment of upward buoyancy about the fore poppet exceeds the downward moment of the weight about the fore poppet. In such a condition, the stern lifts and there is contact with the launching ways only at the fore poppet. This condition is called \_\_\_\_\_.
- Pivoting
  - Tipping
  - Dropping
  - Stern lift
9. Name the two gases whose emission are restricted from the ship as per MARPPOL regulations.
- NO<sub>x</sub>, SO<sub>x</sub>
  - N<sub>2</sub> and H<sub>2</sub>
  - N<sub>2</sub> and O<sub>2</sub>
  - None of the above
10. The SOLAS rules are only applicable for Cargo ships having \_\_\_\_\_ gross tonnage and above
- 200
  - 500
  - 1000
  - 5000

### Section B:

5 out of 7 Questions of 8 Marks Each = 40 Marks

11. The cross sectional areas of a ship, 72 m LBP, 11.5 m beam and 4.3 m draught, are as follows:

Station	0	½	1	1 ½	2	3	4	5	6
CAS (m <sup>2</sup> )	0	17.1	28	35	40	45	46	46	46
Station	7	8	8 ½	9	9 ¼	9 ½	9 ¾	10	
CAS (m <sup>2</sup> )	45	31	24	17	14.2	8	4.9	0	

Determine the volume of displacement, mass of displacement in salt water, LCB, CB, CP, and CM

- 12.
- What effects do liquid free surfaces in a ship have on its stability? Can other cargoes present similar effects?
  - Show that a wall-sided ship with an initial metacentric height, GM, which is negative will loll to an angle  $\phi$ , such that

$$\tan \phi = + \left[ \frac{2GM}{BM} \right]^{0.5}$$

Or

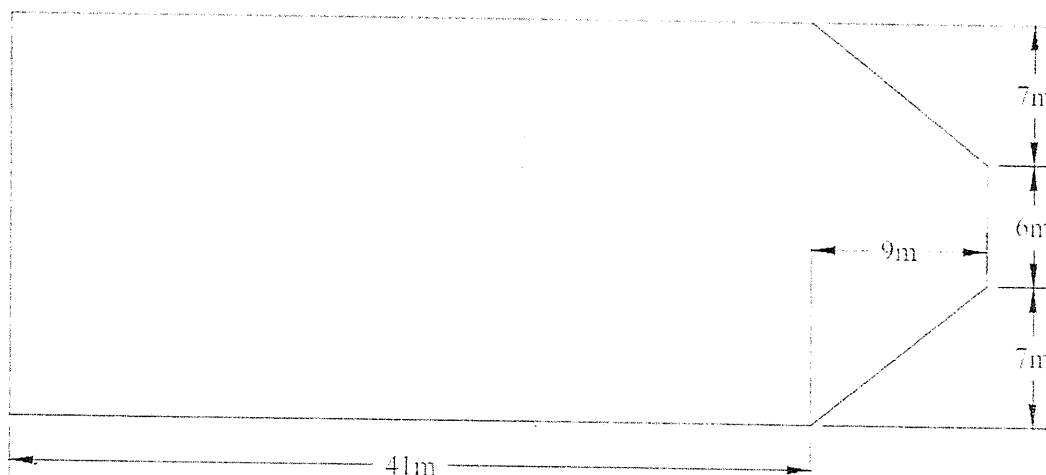
$$- \left[ \frac{2GM}{BM} \right]^{0.5}$$

13. A tanker has displacement of 10,000 tonnes,  $KM = 7\text{m}$ ,  $KG = 6.4\text{m}$ , and  $MCT 1\text{cm} = 150\text{ tonnes m}$ . There is a centerline bulkhead in both No. 3 and No. 8 tanks. The center of gravity of No. 3 tank is 20 m forward of the center of flotation and the center of gravity of No. 8 tank is 30 m aft of the center of flotation. The center of gravity of all tanks is 5 m out from the centerline. At present the ship is listed 4° to starboard and trimmed 0.15 m by the head. Find what transfer of oil must take place if the ship is to complete upright and trimmed 0.3 m by the stern.
14. A box-shaped vessel of length 64 m, beam 10 m and depth 6 m floats upright at a level keel draught of 5 m in standard salt water and  $KG = 3.0\text{m}$ . The vessel has a forward compartment 6 m long and 10 m wide which extends from the keel to a height of 3.5 m. Find the new draughts at the perpendiculars if this compartment is bilged, assuming a permeability of 0.25.
15. Explain in short about the different annexure in MARPOL.
- 16.
- Discuss about the different types of ballast water treatment systems
  - State the reasons for a Rise in G or KG on a ship
- 17.
- Outline the latest IMO probabilistic method for assessing damage stability
  - Discuss the means of transferring ships from dry land to the sea on first build. Describe the slipway and the means of ensuring a successful conventional launch.

### Section C:

1 out of 3 Questions of 10 Marks Each = 10 Marks

18. A wall-sided barge of 50 m L × 20 m B has a constant waterplane shown below.



The barge is operating in seawater at an even keel draught of 3 m. Assume that the centre of gravity of the vessel is at 4 m above keel at all loading conditions.

- a. The vessel sails up-river into a fresh water lake.
- Compute its new draught.
  - Does the barge change trim? (Explain briefly the reason.) If so, what is the change in trim?
  - Compute the position of LCF and hence IL.
- b. She then discharges some cargo as follows:
- 50 tonnes from 20 m aft of midship.  
 The following are loaded:  
 100 tonnes at 15 m aft of midship.  
 10 tonnes at 20 m fwd of midship.
- Compute the new mass and volume displacement.
  - Calculate BML, GML and MCT.
  - Estimate the new draughts fwd and aft.
- c. The barge then returns down-river to sea. Does the trim change? Explain clearly why you think so.

19. For a wall-sided ship with liquid contained in a wall-sided tank, Prove that

$$GZ_F = \sin \theta \left[ \left( GM - \rho \frac{I_\ell}{\nabla_s} \right) + \left( BM - \rho \frac{I_\ell}{\nabla_s} \right) \frac{\tan^2 \theta}{2} \right]$$

20. Explain in detail about floodable length calculation with required graphs and equations.