

Indian Maritime University
(A Central University, Govt of India)

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: V

Subject Code: UG11T4505

Subject Name: NAVAL ARCHITECTURE-I

Date: 11.10.2025

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions: All Sections (A, B & C) are to be attempted and options, if any, are specified in respective section.

Section A

Answer all ten (10) MCQs/Fill in the Blanks of 01 Mark each and choose the correct answer as applicable.

(Marks 10x1=10)

1. ____ is the product of the prismatic coefficient and midship section area coefficient.

- a) Vertical Prismatic Coefficient
- b) Water plane area coefficient
- c) Block coefficient
- d) Form Coefficient

2. Which of the following is correct for a cargo ship?

- a) Deadweight = Displacement – Lightweight
- b) Deadweight = Displacement + Lightweight
- c) Displacement = $L_{BP} \cdot B \cdot T \cdot C_B$
- d) Above statements, a) and c)

3. Rule 3, 10, -1 is made for finding ----

- a. Total area under the curve
- b. Area for a part under the curve
- c. First area moment for the entire part under the curve
- d. First area moment for a part under the curve

4 GM cannot be used as an indicator of stability at all angles of inclination because:

- a. M is not fixed at large angles
- b. G is not fixed at large angles
- c. there is no M at large angles
- d. there is no G at large angles

5. What happens to the righting arm (GZ) at large angles of the heel beyond a certain point?

- a) It continues to increase
- b) It starts to decrease
- c) It remains constant
- d) It fluctuates unpredictably

6. What is the change that happens in the value of MCT 1cm when a vessel moves from fresh water to sea water?

- a) Increases
- b) Decreases
- c) No change happens
- d) Decreases by 2.5 %

7. If a vessel loses its reserve buoyancy, it will _____

- a) Capsize and float on its side
- b) Remain unaffected if the hull remains intact
- c) Most likely sink
- d) Float upright with the main deck awash

8. According to the IMO Code of Intact Stability, what is the primary objective of intact stability requirements?

- a) To ensure a ship can maintain stability under normal loading conditions
- b) To ensure a ship can resist flooding and remain afloat
- c) To ensure stability under various operational conditions, including rough seas
- d) To prevent ships from capsizing under any circumstances

9. In longitudinal strength calculation, the hull girder is treated as a _____

- a) Simply supported beam
- b) Cantilever beam
- c) Free-Free beam
- d) slender column

10. What is longitudinal strength in ship design primarily concerned with?

- a) The ability of the ship to resist rolling in waves
- b) The ability of the hull girder to resist bending stresses from waves
- c) The strength of the ship's cargo hold
- d) The ability of the ship to remain afloat after flooding

Section B

Answer all five (5) Questions of 02 Marks each.

(Marks 5x2=10)

11. What is a Lines Plan in ship design?
12. What is the difference between Simpson's 1st and 2nd Rules?
13. Explain the relationship between the Centre of Gravity (G) and the angle of list.
14. Explain how MARPOL and SOLAS guidelines address damage stability.
15. Explain the type of stresses that occur at the ship deck and keel when a ship encounters waves at sea with a crest at amidships and its troughs at the bow and the stern.

Section C

Answer any five (5) Questions out of Seven (7) Questions of 10 Marks each.

(Marks 5x10=50)

16. a) A ship 135 m long, 18m beam and 7.6m draught has a displacement of 14000 tonnes. The area of the load water plane is 1925 m^2 and the area of the immersed midship section 130 m^2 . Find horizontal and vertical Prismatic coefficients.

b) Draw a typical Load Line Marking for ships except timber ships.

(Marks 4+6)

17. The half ordinates of a ship's water-plane 120 m long are as follows:

stations	AP	1/2	1	1.5	2	3	4	5	6	7	8	8.5	9	9.5	FP
½ ordinates (m)	1.2	3.5	5.3	6.8	8	8.3	8.5	8.5	8.5	8.4	8.2	7.9	6.2	3.5	0

Calculate:

- a) Water plane area
- b) Distance of centroid from midships

(Marks 5+5)

18. An oil tanker 24 m wide displaces 25000 tonnes when loaded in nine equal tanks, each 10 m long, with an oil relative density 0.8. Calculate the total free surface effect with

- no longitudinal divisions
- a longitudinal centreline bulkhead
- twin longitudinal bulkheads, the centre compartment having a width of 12 m and the side compartment 6 m each.

(Marks 3+3+4=10)

19 a) A ship of 12000 tonnes displacement has a second moment of area about the centreline of $72 \times 10^3 \text{ m}^4$. If the metacentric height is -0.05 m, calculate the angle of the loll.

b) Derive the Wall-sided formula given below, where GZ is the righting lever, GM is metacentric height, BM is metacentric radius and θ is the angle of the heel.

$$GZ = \sin \theta (GM + \frac{1}{2} BM \tan^2 \theta)$$

(Marks 4+6)

20. A ship 150 m long has drafts of 7.7m forward and 8.25m aft, MCTC 250 tonne.m, TPC 26 Tonne and LCF 1.8 m forward of midships. Calculate the new drafts at an aft and a forward after the following masses have been added:

- 50 tonne, 70m aft of midships
- 170 tonne, 36 m of midships
- 100 tonne, 5m aft of midships
- 130 tonne, 4m forward of midships
- 40 tonne, 63 m forward of midships

(Marks 5+5)

21. A box-shaped vessel 40 metres long, 8 metres wide and 6 metres deep, floats in salt water on an even keel at a draft of 3 metres. $GM=1$ metre, if an empty compartment 4 metres long and situated amidships is bilged. Find the following:

- before bilging, find the KG
- after bilging, the new draft
- find the new GM

(Marks-3+3+4)

22. A box-shaped barge of uniform construction is 32 m long and displaces 352 tonnes when empty, is divided by transverse bulkheads into four equal compartments. Cargo is loaded into each compartment and level stowed as follows:

- No. 1 holds 192 tonnes,
No. 2 holds 224 tonnes
No. 3 holds 272 tonnes,
No. 4 holds 176 tonnes

Construct Load, shear force and bending moment diagrams.

(Marks: 4+3+3)

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