

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

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: V

Subject Code: UG11T3506

Subject Name: Naval Architecture 1

Date: 17.09.2025

Duration: 03 Hrs

Max Marks: 70

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

Answer all questions. Each question carries 1 mark

Select the most appropriate answer from the given choices for each of the following questions.

1. Which one of the following is a part of the ship's Lightweight

- (a) Crew
- (b) Machinery
- (c) Cargo
- (d) Fuel

2. You are required to find area of waterplane of a ship enclosed between 10 equally spaced stations from AP to FP. Which of the following can you use?

- (a) Tchebycheff's Rule
- (b) Simpson's II rule (1,3,3,1 rule)
- (c) Simpson's, I rule (1,4,1 rule)
- (d) Morrish formula

3. When a ship travels from sea water to fresh water her mean draught _____

- (a) decreases
- (b) increases
- (c) Remains unchanged
- (d) change is unpredictable

4. In which of the following components of ship's lines plan drawing can we measure camber of the deck?

- (a) Body Plan
- (b) Half breadth Plan
- (c) Sheer Plan
- (d) Stem and stern profiles

5. Aim of the Inclining Experiment is to determine

- (a) GM in Loaded condition
- (b) KG in light condition
- (c) BM in light condition
- (d) KB in light condition

6. Longitudinal position of the centre of floatation of a ship is aft of her centre of buoyancy. When this ship travels from sea water to fresh water, she will _____.

- (a) undergo change in trim by stern (b) remain even keel
(c) undergo change in trim by bow (d) undergo reduction in mean draught

7. Which of the following curves could be used to directly estimate Initial GM of a ship?

- (a) Sectional Area Curve (b) Bonjean Curves
(c) Curve of statical stability (GZ Curve) (d) Hydrostatic Curves

8. The difference between the total watertight volume of the ship and the volume of its submerged part when floating is called as

- (a) Buoyancy (b) Reserve of buoyancy
(c) Displacement (d) Residual buoyancy

9. For which of the following curves of a ship the areas above and below the base line are equal.

- (a) Shear Force Curve (b) Bending Moment Curve
(c) Load Curve (d) all of the above

10. In the lost buoyancy method of damaged stability calculations, which one of the following will remain same as in intact condition.

- (a) Metacentre (b) Centre of floatation
(c) Centre of Buoyancy (d) Centre of Gravity

Section B

Answer all questions. Each question carries 2 marks

11. Explain angle of Loll. How can it be corrected?
12. What are Bonjean curves? What is their use?
13. With respect to flooding of a ship due to damage, what is the relevance of 'Bulkhead deck' and the 'Margin Line'.
14. Distinguish between stiff and tender ships.
15. Define TPC and explain how it varies with draught and density of water.

Section C

**Answer any five questions. Marks. Each question carries 10 marks.
Marks carried by sub-questions are as shown.**

16. (a) A ship of length 200m has a beam of 22m and a draught of 7m. if the prismatic coefficient is 0.75 the area of waterplane 3500 m² and mass displacement in salt water is 23000 tonnes, estimate (i) Block Coefficient
(ii) Waterplane area coefficient (iii) Midship area coefficient. (4 Marks)

(b) The half-breadths (in metres) of load waterplane of a ship at 11 stations 12.2 metres apart are: 2.0, 7.3, 9.8, 10.4, 10.6, 10.7, 10.6, 9.9, 7.8, 4.2, and 0.2 respectively, commencing at the aft end. Determine the area and centre of floatation relative to the midship station. (6 Marks)

17. (a) An inclining experiment was undertaken on a vessel of 8000 tonnes displacement. An existing mass of 10 tonnes was moved 14 m across the deck causing a pendulum 8.50 m long to deflect. Average deflection was found to be 110 mm. KM_T is 7.15 m. Calculate KG of the ship. (4 Marks)

(b) Bilge keels of mass 36 tonne and having a volume of 22 m^3 are added to a ship. If the TPC is 20, find the change in mean draught. Assume ship floating in sea water of RD 1.025. (3 Marks)

(c) A triangular bulkhead is 7 m wide at the top and has a vertical depth of 8 m. Calculate the load on the bulkhead if the bulkhead is flooded with sea water on only one side with 4 m head to the top edge. (3 Marks)

18. (a) Determine the change in mean draft when a ship of 9920 tonne displacement and a TPC of 16.1 passes from water of density 1.008 tonne/m^3 to sea water of density 1.024 tonne/m^3 (5 Marks)

(b) A wall sided ship of 7200 tonne displacement has KG 5.2 m, KB 3.1 m and KM 5.4 m. 300 tonne of fuel (RD 0.8) at Kg 0.6 m are now used from a centreline tank which results in a free surface 6 m long and 8 m wide. Calculate the angle to which the vessel will heel. Assume that KM remains constant. (5 Marks)

19. (a) Draw a typical curve of statical stability (GZ Curve) for an initially stable ship and show the following features on it: (i) Angle of vanishing stability (ii) Range of stability (iii) initial GM (iv) Max GZ and angle of Max GZ (vi) Point of inflection and Angle of deck edge immersion (6 Marks)

(b) Calculate the dynamical stability at 40° heel, for a ship which displaces 6000 tonnes and which has the following righting levers:- (4 Marks)

Heel (degrees)	10	20	30	40
GZ (m)	0.18	0.41	0.67	0.85

20. (a) A ship 120 m long has draughts of 6.6 m forward and 6.9 m aft. The TPC is 20 t/cm, $MCT1\text{cm}$ 101 tonne m/cm and the centre of flotation 3.5m aft of midships. Calculate the maximum position aft at which 240 tonne mass may be added so that the after draught does not exceed 7.2 m. (5 Marks)

(b) A vessel about to enter a port has Draught Fwd = 11.2 m, Draught Aft = 12.0 m, $MCTC$ = 210 Tonne.m/cm, LCF 95 m fwd of AP and Length 200 m. The ship is required to enter the port on an even keel. Find the amount of water ballast to transfer from a tank at LCG 80 m forward of AP to a tank at LCG 195 m forward of AP. Determine the final even keel draft. (5 Marks)

21. A box barge of uniform construction is 40 m long is divided by transverse bulkheads into four equal compartments. She displaces 2000 tonnes when cargo is loaded into each compartment and level stowed as follows: 300 tonnes in No.1 hold; 420 tonnes in No.2 hold; 480 tonnes in No. 3 hold; and 280 tonnes in No. 4 hold. Draw the load, shearing force and bending moment diagrams, showing position and value of maximum bending moment. (10 Marks)

22. A box-shaped vessel 150 m long, 20 m beam, is floating upright in salt water at an even keel draft of 6 m. The collision bulkhead is situated 8 m from forward. Find the new drafts if the vessel is now bilged forward of the collision bulkhead. (10 Marks)

