National Exams May 2016

98-Nav-A1, Fundamentals of Naval Architecture

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM. Any non-communicating calculator is permitted.

3. FIVE (5) questions constitute a complete exam paper. The first five questions as they appear in the answer book will be marked.

4. Each question is of equal value.

5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

1. a) Explain briefly what is meant by longitudinal and transverse framing. Use sketches to illustrate your description.

b) A barge having a length of 72.00 metres, a breadth of 12.00 metres, and a draft of 4.00 metres, floating on even keel in water of density 1.025 tonne/m^3. The vertical center of gravity of the loaded barge is 3.50 metres. The barge has a tank resting on the bottom half filled with oil of specific gravity 0.8. The tank has a length of 15.00 metres and breadth of 10.00 metres.

Calculate the displacement and the transverse metacentric height of the barge. If a weight of 75.00 metric tonnef, which was originally on the barge's deck, was moved transversely from port to starboard a distance of 6.00 metres. Calculate the resulting angle of heel of the barge.

2. a) Explain briefly what is the free surface effect.

b) A ship 150.00 metres floats at drafts of 8.20 metres forward and 8.90 metres aft. The ship has the following particulars:

TPC = 28 MCT 1cm = 260 tonnef. metre
LCF = 1.5 metres aft of midship

A double bottom tank whose dimensions are 20.00 metres long, 10.00 metres breadth, and 1.2 metres depth is filled completely with oil of specific gravity of 0.8. The longitudinal centerline of the tank coincides with the centerline of the ship and its center is located at a distance of 50.00 metres aft of midship section. Determine the new forward and aft drafts of the ship

3. a) Explain briefly what is meant by the terms: Freeboard and Floodable length.

b) A ship of length 150.00 metres is floating in sea water with drafts of 7.70 metres and 8.25 metres measured at the forward and aft marks, respectively. The forward draft marks are 2.00 metres aft of the forward perpendicular and the aft draft marks are 20.00 metres forward of the after perpendicular. If a weight of 250.00 tonnef is placed 20.00 metres forward of amidships, find the new draft marks' readings.

The Ship has the following particulars at the even keel draft corresponding to the above drafts:

TPC = 26 MCT 1cm = 250 tonnef. Metre
LCF = 1.80 metres forward of midship section.

4. A box-shaped barge 60.00 metres long, 10.50 metres beam floats at a draft of 3.00 metres in sea water. The barge is divided by a longitudinal bulkhead and four transverse bulkheads. The bulkheads divide the barge into 10 identical watertight compartments. The centre of gravity of the barge is 2.5 m above the keel. The empty compartment whose centre is 24.0 m forward of the midship section and on the starboard side of the centerline longitudinal bulkhead has been flooded. Calculate the trim angle after flooding.

5. The displacement of a 135.00 metres long ship is 72100.00 tonnef. The half ordinates of its design waterplane are given as

Station	FP	2	3	4	5	6	7	8	9	10	AP
Beam/2, metres	0.00	6.40	9.75	11.25	12.35	13.10	13.35	13.30	13.10	12.20	11.28

Calculate

- The waterplane area.
- The distance of the center of the waterplane from the midship section.
- The transverse second moment of the waterplane area.
- The longitudinal second moment of area about a transverse axis passing through the center of area of the waterplane.
- The value of the transverse BM.
- The value of the longitudinal BM.

6. a) Define the volume permeability and the surface permeability.

b) A ship of length 140.0 metres is floating in sea water at drafts of 7.70 metres forward and 8.25 metres aft. The ship has the following particulars:

TPC = 24 MCT 1cm = 252 tonnef. Metre
LCF = 2.16 metres forward of amidships

Calculate the new drafts after adding the following weights:

Weight (tonnef)	LCG from amidships (metres)
50.00	70.00 aft of midship
170.00	36.00 aft of midship
100.00	5.00 aft of midship
130.00	4.00 forward of midship
40.00	63.00 forward of midship

7. a) What precautions need to be taken during the performance of an inclining experiment.

b) A ship floating at sea, has a lightship displacement of 3500.00 tonnef, and during an inclining experiment the pendulum was inclined at an angle of 1.3 degrees when a weight of 6.00 tonnef was moved transversely across the deck a distance of 10.00 metres. During the inclining experiment there was an oil tank on board. The tank is 7.50 metres long, 15.00 metres wide, and 8.00 metres deep. The level of the oil in the tank was 4.00 metres high. The tank bottom was resting on the ship's bottom and the oil specific gravity was 0.8. The centerline of the tank is aligned with the centerline of the ship.

If the oil in the tank is completely removed and a weight of 25.00 tonnef, already onboard, is moved a distance of 10.00 metres in the transverse direction, calculate the angle of heel of the ship. Assume that the ship is wall sided.

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Data Sheet

Water Properties

Type	Property	SI	Metric	British
Sea Water	Density	1025.00 Kg/m^3	1.025 tonne mass/m^3	1.99 slug/ft^3
	Specific weight	10.055 KN/m^3	1.025 tonnef /m^3	64.00 lb/ft^3
Fresh Water	Density	1000.00 Kg/m^3	1.0 tonne mass/m^3	1.94 slug/ft^3
	Specific weight	10.00 KN/m^3	1.0 tonnef/m^3	62.4 lb/ft^3

$TPI = \frac{A_w}{420}$ for salt water

$TPC = \rho\ A_w \times 10^{-5}$ tonnef /m , area in m^2 and density in Kg/m^3

$MCT\ 1\ inch = \frac{I_L}{420\ L}\ ton.ft$ for salt water

$$MCT\ 1m = \frac{0.01005\ I_L}{L}\ MN.m\ for\ sea\ water$$

Rules for numerical Integration

Trapeziodal Rule

$$A = \frac{h}{2}\left[y_o + 2\,y_1 + 2\,y_2 + 2\,y_3 + \ldots + y_n\right]$$

Simpson's First Rule

$$A = \frac{h}{3}\left[y_o + 4\,y_1 + 2\,y_2 + 4\,y_3 + \ldots + 4\,y_{n-1} + y_n\right]$$

Marking Scheme

1. 20 marks total
   a. 6 marks
   b. 14 marks
2. 20 marks total
   a. 6 marks
   b. 14 marks
3. 20 marks total
   a. 6 marks
   b. 14 marks
4. 20 marks total
5. 20 marks total
6. 20 marks total
   a) 6 marks
   b) 14 marks
7. 20 marks total
   a) 6 marks
   b) 14 marks