National Exams December 2012

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 Casio or Sharp approved 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 rectangular barge 18.0 metres long and 6.0 metres wide, has a displacement of 300 metric tons when floating in sea water. Its centre of gravity is 2.5 metres above the keel. Show that when floating upright in seawater it is in a condition of unstable equilibrium.

   Sixty metric tons of solid ballast are now placed in the barge, the ballast center of gravity is at a distance 0.50 metres above the keel. Calculate the resulting transverse metacentric height.

2. A ship has a displacement of 6150.0 metric tons in sea water, floats at a waterline whose half-ordinates at equal intervals of 11.0 metres long, starting from the forward perpendicular are:

   0.0, 2.22, 4.48, 6.21, 6.98, 7.0, 6.95, 6.19, 4.2, 1.95, and 0 metres.

   The centre of gravity was 1.5 metres above the centre of buoyancy before a cargo of 120.0 metric ton was loaded at a point 45.0 metres aft of amidships, and 60.0 metric tons of material already on board is moved 12.0 metres forward of its original position. What is the combined effect of these two alterations on the draft aft assuming that the ship is wall sided.

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

   b) A ship of length 160.0 metres is floating in sea water with drafts of 4.2 metres and 4.8 metres measured at the forward and aft marks, respectively. The forward draft marks are 2.0 metres aft of the forward perpendicular and the aft draft marks are 20.0 metres forward of the after perpendicular. If a weight of 100.0 metric tons is placed 18.0 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 = 22.5 MCT 1m = 20800 metric ton. metre
   LCF = 6.0 metres abaft the midship section.

4. A ship with constant rectangular cross-section is 80.0 metres long and 12.0 metres beam and floats with an even keel draft of 3.0 metres in Sea water. Its center of

gravity is amidships and 4.0 metres above the keel. A compartment forward is formed by two transverse watertight bulkheads which are respectively 20.0 metres and 30.0 metres forward of amidships. This compartment contains cargo and has an average permeability of 0.7, and surface permeability of 0.9. Determine the drafts of the vessel and the new value of the transverse metacentric height when the compartment is opened to the sea.

5. The half ordinates in meters, of a water-plane 240.0 metres long, at equally spaced stations starting from aft are:

   0, 11.11, 17.23, 19.81, 20.00, 20.00, 20.00, 19.91, 19.12, 13.82, and 0.

   Calculate the area of the water-plane, the distance of the LCF from the midship section, the transverse second moment of area about the longitudinal axis.

6. A ship of length 140.0 metres is floating in sea water. The ship is loaded as follows:

Item	Weight (metric tons)	LCG from amidships (metres)
Lightship	3500	1.90 A
Cargo	8000	3.75 F
Fuel	800	9.30 A
Stores	25	13.40 F
Fresh water	95	15.00 A
Crew and effects	10	5.00 F

The even - keel draft corresponding to the total displacement is 7.50 metres and at that draft the ship has the following particulars:

TPC = 19.6 MCT 1metre = 15500.00 metric ton. metre
LCB = 1.50 metres Aft of the midship section.
LCF = 2.05 metres Aft of the midship section

Calculate the drafts fore and aft.

7. A ship having the following particulars is floating in fresh water:

Length =	100.00 meter	Beam =	20.00 meter
Draft =	8.00 meter	KG =	5.00 meter
KB =	6.00 meter.	C_b =	0.6
C_w =	0.75		

An inclining experiment was carried out and GM was found to be 5.00 meters. During the experiment, there was an oil tank on board. The tank is 7.50 meters long, 15.00 meters wide, and 8 meters deep. The level of the oil in the tank was 4.00 meters 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 200.00 metric ton, already onboard, is moved a distance of 10.00 meters 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

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

Simpson's First Rule

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

Marking Scheme

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