Date: 22 Nov., 2010 AN **Time: 3 Hrs.** **Full Marks: 50**

End-Autumn Semester Examination

Dept. of Ocean Engineering & Naval Architecture

Subject Number: NA21101 ***Subject Name: Hydrostatics & Stability***

2nd Year B.Tech in OE & NA ***Number of Students : 46***

Answer all questions.

Symbols have their usual meaning if not specified. Assume realistic value of data if missing.

1. (a) The hull form of a ship of length L, breadth B and draft T is represented by the equation : $\pm y = f(x,z)$ where x is measured along length, y transversely and z vertically, the origin of coordinates being at the after end on the base line. Give integral expressions for (a) waterplane area, (b) longitudinal center of flotation, (c) the two moments of inertia of the waterplane through center of flotation, (d) volume, (e) vertical center of buoyancy, (f) longitudinal center of buoyancy (4)

   (b) If a curve is defined by 6 ordinates y_1-y_6 at equally spaced intervals with spacing h, show that the application of (5,8,-1) rule and at the two ends and (1,3,3,1) rule at the middle produces the following formula for the area A :

   $$A = \frac{25}{24} h(0.4y_1 + \sum_{i=2}^{5} y_i + y_6)$$

   If A_1 is the area obtained by application of (1,4,1) rule for the first 3 ordinates and (1,3,3,1) for the rest part, then show that $A=A_1$ when the curve is a straight line. (4)

2. (a) Explain the concept of cross-curves of stability, and a method to determine these. (4)

   (b) Explain the significance of dynamic stability. How would you find the maximum and steady roll angles when a healing moment acts? How would you determine the maximum angle of heal if it is assumed that the ship was at an initial angle $-\varphi_i$ when the heeling moment starts acting? (4)

.....continued overleaf.....

3. (a) Explain the added weight and lost buoyancy methods for damage stability calculation. (4)

(b) Consider a rectangular box of length 20m, breadth 5m. and draft in intact condition of 1.5m. The barge is divided into three compartments by two bulkheads located at 8m and 12m from aft end. The CG is located 1.5m. above keel. Determine the new drafts, KB, BM and GM when the central compartment gets flooded, by using both added weight method and lost buoyancy method. Compare the results from the two methods, Are all the quantities and in particular the GM calculated from the two methods same? If not, how do you explain this phenomenon and how do you ensure that the two methods results in the same stability characteristics? (6)

4. (a) Define floodable length, permissible length, permeability and damage stability. By a suitable sketch, show how floodable length is related to (transverse) subdivision of a vessel, and how it is plotted and how it can be checked that the subdivisions are within permissible length. (4)

(b) A rectangular barge of length 50 m, breadth 10 m, and depth 8 m is to have a draft of 6 m. The barge must be subdivided to withstand flooding. What is the maximum length of a compartment located centrally which when flooded will result the deck to be just 100 mm above waterline. Note that there are no interim decks between keel and the upper deck. Also compute the undamaged and damaged GM. Assume KG=6m. Assume volume permeability to be 0.95 and surface permeability to be 0.90. (4)

5. (a) Sketch a profile of a ship on the launching ways and explain the terms standing ways, sliding ways, fore poppet, aft poppet, and way-end. (3)

(b) What are launching curves? Show a typical schematic diagram of launching curves with appropriate labels and the important information it provides. (4)

(c) Briefly discuss (i) different components of ship's weight (ii) grain capacity, bale capacity and tank capacity (iii) gross and net tonnage (3)

6. It is desired to fit a gun mounting weighing 200 KN to a ship without altering the draft at the propellers which are located at 5 m. forward of the AP. The drafts before the gun mounting is fitted are 2.7 m at FP and 3.1 m. at AP. Other particulars at this draft are: LBP=45m., (mass) displacement = 260 tons, moment to change trim by 1 cm = 200 KN-m, LCF=2.3m. aft midship, tons per cm of immersion = 2. Where should the gun-mounting be fitted and what will be the resulting drafts at AP and FP ? (6)

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