DEC 10

NAVAL ARCHITECTURE I

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

1. The load waterplane of a ship is 144 m long, floating in sea water of density 1025 kg/m³, is defined by the half ordinates given in Table Q1:

Station	AP	½	1	2	3	4	5	6	7	7½	FP
Half ordinates (m)	2.0	4.8	6.6	8.7	9.5	9.6	9.5	8.2	4.8	2.4	0

Table Q1

The following particulars are obtained from the ship's hydrostatic curves:

displacement	=	13640 tonne
centre of buoyancy above the keel (KB)	=	3.84 m
moment to change trim by one centimetre (MCT 1cm)	=	176.5 tm

Calculate EACH of the following:

(a) the position of the longitudinal centre of flotation (LCF) from midships; (6)

(b) the second moment of area of the waterplane about a transverse axis through the centroid; (6)

(c) the height of the ship's centre of gravity above the keel (KG). (4)

2. For a box shaped barge 100 m in length, 15 m breadth, floating at an even keel draught of 8 m in sea water of density 1025 kg/m³, the KG is 5 m.

A full breadth midship compartment 10 m long is divided by a centreline watertight longitudinal bulkhead to form two equal compartments.

Calculate the angle of heel for the barge, if one compartment is bilged.

The permeability of the flooded compartment is 85% (16)

3. A ship of length 130 m has a light displacement of 4750 tonne with the longitudinal centre of gravity 0.5 m aft of midships.

Loading now takes place as given in Table Q3.

Load	Mass (tonne)	lcg from midships (m)
cargo	3500	37.5 forward
cargo	4050	29.5 aft
oil fuel	550	14.2 forward
fresh water	100	52.0 forward
stores etc	50	32.2 aft

Table Q3

Determine the final end draughts of the vessel in the sea water of density 1025 kg/m^3 using the relevant data extracted from the hydrostatic curves provided on Worksheet Q3. (16)

4. A uniformly constructed box shaped vessel of length 80 m and breadth 12 m has an even keel draught of 2 m when floating in the light condition in sea water of density 1025 kg/m^3.

The vessel has five holds of equal length and is to be loaded with 7000 tonne of cargo, with equal quantities in each of the centre and end holds, and the balance equally distributed in No. 2 and No. 4 holds.

The cargo in all holds will be trimmed level.

Calculate EACH of the following:

(a) the maximum amount to be loaded in the centre and end holds in order that a maximum hogging bending moment amidships of 4000 tm will not be exceeded. (12)

(b) the resulting shear force at each of the bulkheads. (4)

7. (a) State the benefits of aluminium alloy as a construction material for a ship, describing its application. (6)

(b) State the disadvantages of using aluminium alloy. (4)

(c) Describe, with the aid of a sketch, how the problem of galvanic corrosion between a steel hull and aluminium alloy superstructure is overcome. (6)

8. (a) Describe, with the aid of a sketch, a set of lifeboat gravity davits. (9)

(b) List the launching procedure associated with the davits described in Q8(a). (7)

9. (a) Explain how a force normal to the rudder is produced when the rudder is turned to a helm angle. (3)

(b) Define the term *centre of effort* as applied to a rudder. (1)

(c) Describe how the position of *centre of effort* changes as helm angle increases. (2)

(d) Explain the term *balanced*, describing the benefits of fitting a balanced rudder. (3)

(e) Describe, with the aid of a sketch, how an angle of heel is produced due to the force on the rudder. (7)