



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 3 Examination in Engineering: July 2022

Module Number: MN3304

Module Name: Hydrostatics and Stability of
Marine Vessels

[Three Hours]

[Answer any FIVE questions]

Given Seawater density = 1.025 ton/m^3

Q1. Explain the following with appropriate sketches

- i. Metacentre and Metacentric height.
- ii. Unstable equilibrium condition of a ship and Angle of loll.
- iii. Free surface effect of liquid in tanks.
- iv. Purpose of inclining experiment.

[12 Marks]

Q2. A rectangular barge has the dimension $L=100\text{m}$, $B=20\text{m}$, $D=8\text{m}$ and $T=5\text{m}$ with usual notation. The barge has a crane whose suspension point is 8m above the deck and the 15m off the centerline. The Crane lift a mass of 50 ton from the shore. Find the angle of inclination of the barge

- i. Assuming metacentre is a fixed point,
- ii. Using wall sided formula $GZ = \sin\theta(G_oM_o + \frac{1}{2} B_oM_o \tan^2\theta)$

You may consider initial centre of gravity of the barge is 9.5m above the keel.

[12 Marks]

Q3. A tanker of displacement 1480 ton has the following values of the cross curves of stability for an assumed KG of 3.8m.

Angle of heel(deg)	5	10	15	20	30	40	50	60
KN (m)	0.051	0.086	0.091	0.10	0.159	0.225	0.213	0.168

Draw the righting lever of the vessel at KG_{fluid} of 3.595m and show that all intact stability criteria are satisfied.

Now, 80 ton of oils is consumed from the No.1 port tank whose centre of gravity is 4.0m off the centerline and free surface moment is 79 t.m. Find the list of the vessel using modified righting lever curve.

[12 Marks]

Q4. A rectangular barge of 80m long, 15m beam floats at a draft of 4m in the seawater. The barge has horizontal deck at a height of 4.5m above the keel. The end compartment, bounded by bulkheads 15m and 30m away from the midship, is damaged and open to the sea.

Find the final drafts values and change of metacentric height of the barge after flooding. You may assume permeability of 100%.

[12 Marks]

Q5. A ship arrives at a port with following condition;

Forward draft	= 8.2 m
Aft draft	= 8.7 m
Displacement	= 8450 t
Length between perpendiculars	= 140m.

Now,

1. 200 t is loaded at a distance of 40m forward of midship
2. 300 t is unloaded at a distance of 60m forward of midship
3. 100 t is moved forward by 30m.

Find the final draft values at the perpendiculars assuming following hydrostatics remain same.

Note:

TPC = 36, LCF = 0.3 m aft, LCB = 3.0m forward and MCTC = 48 t.m

[12 Marks]

Q6. An inclining experiment was carried out on a vessel of 79m LBP. The following data were recorded during the experiment.

Draft aft	= 1.72m
Draft fwd	= 1.41m
Length of pendulum	= 4.3m
Distance through weight is moved	= 4.0m

Weight moved (t)	Pendulum deflection (mm)
3	43 P
6	81 P
3	45 S
6	82 S

Using following hydrostatic particulars, estimate KG and LCG of the vessel.

Draft (m)	Disp (t)	MCTC (t.m)	TPC (t)	LCB (m)	LCF (m)	KM (m)
1.20	575.10	20.31	6.13	2.19 aft	1.89 aft	10.44
1.40	695.24	21.09	6.25	2.13 aft	1.79 aft	9.17
1.60	817.19	21.73	6.34	2.08 aft	1.69 aft	8.21
1.80	940.96	22.23	6.40	2.03 aft	1.59 aft	7.44

[12 Marks]