



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 3 Examination in Engineering: March 2023

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
Graph papers should be provided

Q1. Describe the following with appropriate sketches.

- i) Lines plan of a ship
- ii) Freeboard and freeboard deck of a ship
- iii) Initial metacentric height of a vessel.
- iv) Unstable vessel and angle of loll

[12 Marks]

Q2. A ship 100 m long has MCTC 300 t.m requires 1200 tonnes of cargo to complete loading and is at present floating at drafts of 5.7 m and 6.4 m forward and aft respectively. The ship loads 600 tonnes of cargo in a space whose center of gravity is 3 m forward of amidships. The drafts are then 6.03 m forward and 6.67 m aft. The remainder of the cargo is to be loaded in No. 1 hold (center of gravity 43 m forward of amidships) and in No. 4 hold (center of gravity 37 m aft of amidships). Find the amount, which must be loaded in each hold to ensure that the draft aft will not exceed 6.8 meters. LCF is assumed to be at amidships.

[12 Marks]

Q3.

Figure Q3 shows a cross sectional plan of a fuel oil tank in a ship. Three cross sectional plans given by WL of each spacing 1.5m represents tank. Full breadth values of the tank at each sectional plane is given in centimeters at seven station each spacing of 1.0m. Calculate

- i) Total volume of the tank.
- ii) Centre of gravity LCG of the tank when it is fully filled.

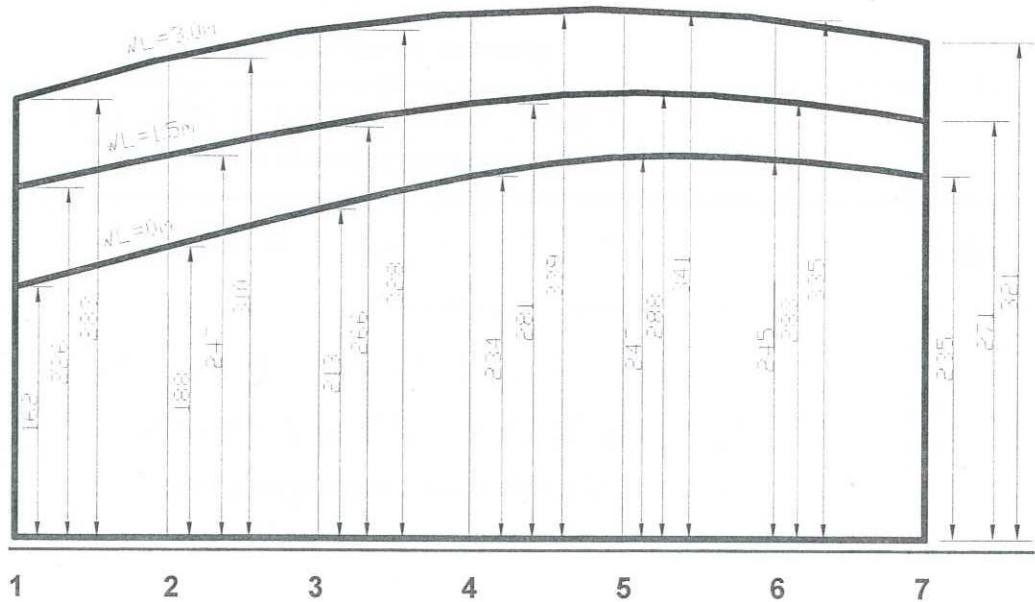


Figure Q3: Waterline Plan of the Tank

[12 Marks]

Q4.

A vessel is loaded up and ready for departure. KM is 11.9 m. KG is 9.52 m with a displacement of 20550 tonnes. From the ship's Cross Curves of Stability, the GZ ordinates for a displacement of 20550 tonnes and a VCG of 8 m above base are as follows

Angle of Heel (deg)	15	30	45	60	75	90
GZ(m)	1.10	2.22	2.60	2.21	1.25	0.36

Using this information, construct the ship's Statical Stability curve for this condition of loading and determine the following:

- i) Maximum righting lever GZ.

- ii) Angle of heel at which this maximum GZ occurs.
- iii) Area of GZ curve up to 30 degrees of heel.
- iv) Range of stability.

[12 Marks]

Q5.

An inclining experiment was carried out on a 60 m LBP vessel floating at drafts of 0.978 m forward and 2.381 m aft. in water of density 1.018 t/m³. A mass of 3 tonne is moved across the deck through a distance of 9m and the deflection of a 6m long pendulum is recorded as follow.

Movement	deflection
P to S	40 mm
S to P	43 mm

Using following hydrostatics particulars refer to seawater density of 1.025 t/m³, determine,

- i) The displacement the vessel
- ii) The KG and LCG of the vessel

Draft (m)	Displ (t)	TPC (t)	LCB (m)	LCF (m)	MCTC (t.m)	KM (m)
2.00	693	4.11	1.39 aft	1.12 aft	11.2	5.08
2.20	776	4.17	1.36 aft	1.04 aft	11.6	4.86
2.40	860	4.24	1.33 aft	0.96 aft	12.1	4.68

[12 Marks]

Q6.

The following particulars are given for a loading condition of a vessel

Lightship displacement	- 750.0 t
Length between perpendiculars	- 56.2 m
Lightship LCG	- 2.228 m aft of midships
Lightship KG	- 3.849 m above the keel

Details of masses to be loaded

Cargo	506 t	at lcg 15 m aft of midships, Kg 5.91 m
Fuel	150 t	at lcg 1.26 m fwd of midships, Kg 1.05 m
Freshwater	37 t	at lcg 7.55 m aft of midships, Kg 1.21 m
Water Ballast	65 t	at lcg 11.42 m fwd of midship, Kg 1.17 m

Hydrostatics particulars

Draft (m)	Displ (t)	TPC (t)	LCB (m)	LCF (m)	MCTC (t.m)	KM (m)
3.80	1491	4.79	0.94 aft	0.35 fwd	16.7	4.36
3.82	1501	4.80	0.94 aft	0.37 fwd	16.8	4.36
3.84	1511	4.81	0.93 aft	0.39 fwd	16.9	4.46

Calculate,

- i) The forward and aft draughts
- ii) The metacentric height at the end loading.

[12 Marks]