UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

OCTOBER 2025 SEMESTER SESSION

SUBJECT CODE	:	**LNB21903**
SUBJECT TITLE	:	**NAVAL ARCHITECTURE 2**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF ENGINEERING TECHNOLOGY (NAVAL ARCHITECTURE AND SHIPBUILDING) WITH HONOURS**
TIME / DURATION	:	**9.00 AM - 11.30 AM (2 HOURS 30 MINUTES)**
DATE	:	**24 JANUARY 2026**

INSTRUCTIONS TO CANDIDATES

1. Please **CAREFULLY** read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **ONE (1) section** with FIVE (5) questions.
4. Answer **ONLY FOUR (4)** questions.
5. Please write your answers on the answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Formula is appended for your reference.

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

(Total: 100 marks)

INSTRUCTION: Answer only FOUR (4) questions.
Please use the answer booklet provided.

Question 1

With reference to the hydrostatic calculation.

A ship 32 m long and 6.4 m beam, floats at even keel draught of 2.5 m in sea water. At this draught her waterplane area coefficient is 0.84, LCF is 17.3 m from FP and second moment of area about amidships, I_L is 2576 m^4. The centre of buoyancy is 1.56 m above the keel. Half Sectional areas up to the draught are as follows.

Station	0	½	1	1 ½	2	2 ½	3	3 ½	4
½ A_s (m^2)	5.9	7.5	8.2	8.5	8.6	7.8	6.2	4.1	2.8

Find for a draught of 2.5 m:

a) Waterplane Area, A_w (2 marks)
b) LCF from amidships (2 marks)
c) Second moment of area about LCF, I_{LCF} (3 marks)
d) Volume of displacement (10 marks)
e) Mass of displacement (2 marks)
f) BM_L (2 marks)
g) KM_L (2 marks)
h) C_P (2 marks)

Question 2
With reference to the ship hydrostatics.

(a) If the ship arrived in port with a mean draught of 7.0 m, discharged her cargo, loaded 300 tonnes of bunkers and completed with a mean draught of 5.8 m. Refer to the hydrostatic particulars below find how much cargo she discharged.

Draught (m)	Displacement (tonnes)
8.00	14820.0
7.50	13140.0
7.00	11480.0
6.50	9870.0
6.00	8280.0
5.50	6730.0
5.00	5220.0

(8 marks)

(b) A ship has a displacement of 13500 tonne in sea water. Its centre of gravity is 5.8 m above keel and its centre of buoyancy is 2.9 m above the keel. If the second moment of area of the waterplane about centerline is 48.5×10^3 m^4, find the metacentric height, GM_T.

(7 marks)

(c) A ship of 6200 tonnes displacement has its centre of gravity 1.4 m fwd of midships and 4.6 m above the keel. 260 tonnes of cargo are then removed at 40 m fwd of midships and 7.5 m above the keel. Find the new position of :

(i) Longitudinal centre of gravity, LCG (5 marks)

(ii) Vertical centre of gravity, KG (5 marks)

Question 3

With reference to large angle stability.

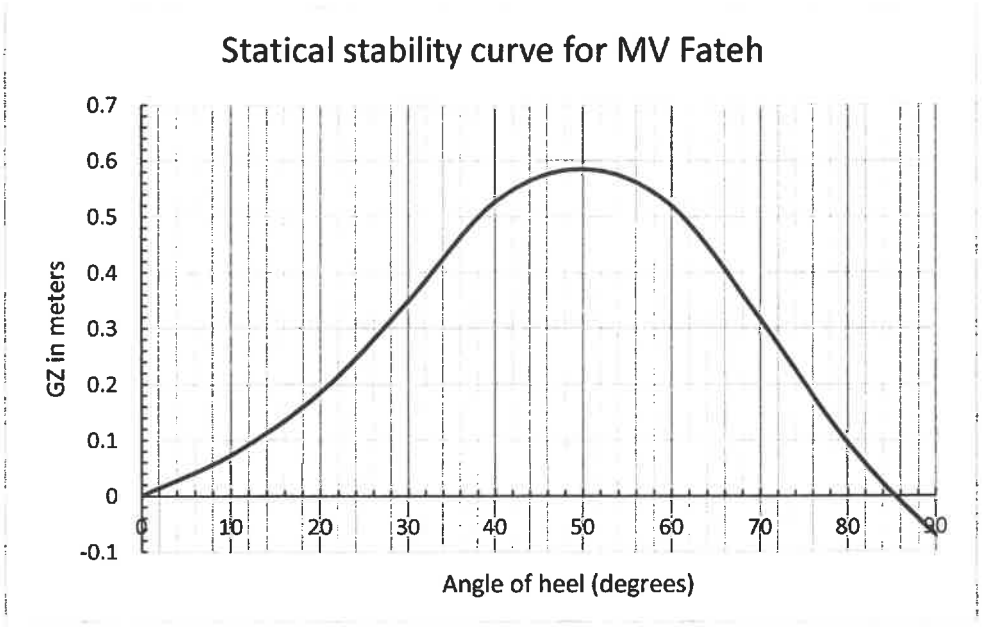


Figure 1: Curve for MV Fateh at 5500 tonnes displacement

Statical stability curve for MV Fateh at 5500 tonnes displacement is shown in Figure 1. From the above figure, determine:

a) Range of stability. (2 marks)

b) Initial GM, GM_o. (2 marks)

c) GZ maximum. (2 marks)

d) Angle of heel at GZ maximum. (2 marks)

e) Angle of vanishing stability. (2 marks)

f) According to the international code on intact stability, 2008, the area under the righting lever curve (statical stability curve/GZ curve) up to 40 degrees angle of heel should not be less than 0.09 meter-radians. Determine and comment on stability criteria for MV Fateh GZ curve up to 40 degrees angle of heel.
(Note: degree to radian is degree x π/180)

(15 marks)

Question 4

With reference to angle of list calculation.

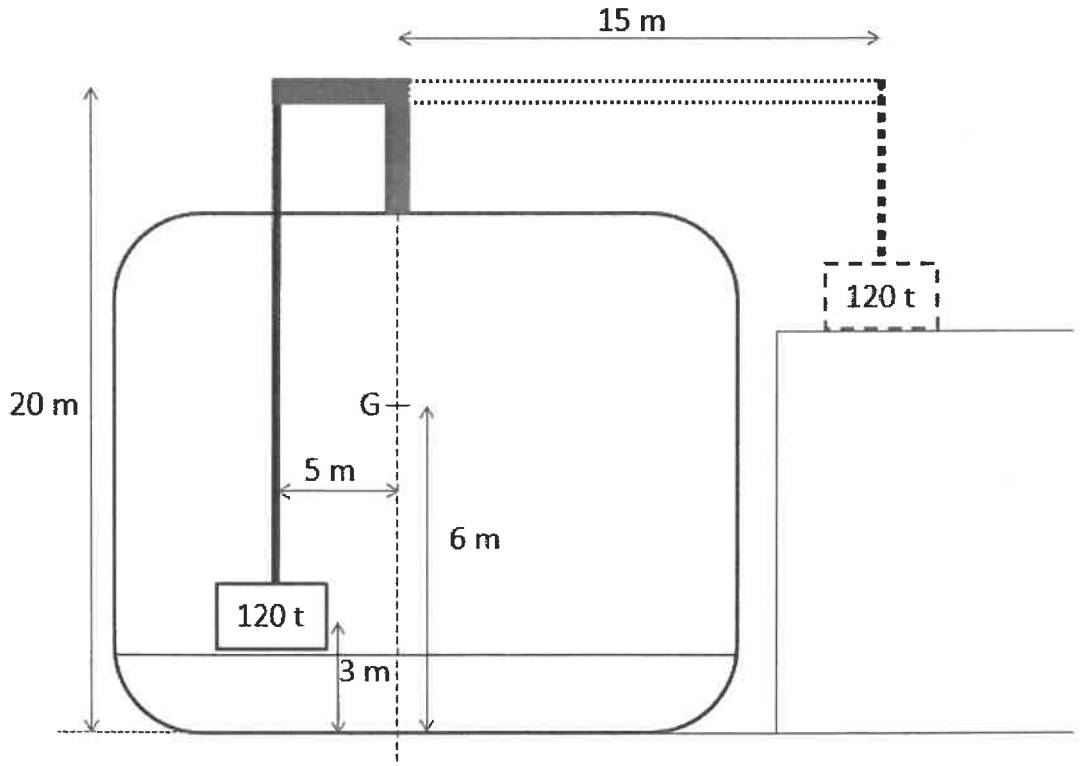
A ship of 9000 tonnes displacement has KM 7.6 m, KG 6 m is listed 5° port. She has to be discharged a weight of 120 tonnes from No 3 Lower Hold using her jumbo derrick whose head is 20 m above the keel and located at centre line. Given centre of gravity of the weight is 3 m above the keel and 5 m to port from centre line.

Calculate angle of list:

(a) As soon as the derrick lifts the weight from Lower Hold (10 marks)

(b) When the derrick has swung the weight 15 m to starboard from centreline (6 marks)

(c) After discharging the weight (9 marks)



Question 5

With reference to the curves of statical stability(GZ).

The heeling angle and the corresponding righting levers, GZ for a ship of 14500 tonnes displacement at an assumed KG of 6.15 m are as follows:

Heeling angle, θ	0	15	30	45	60	75	90
GZ, m	0	0.12	0.34	0.58	0.37	- 0.06	- 0.45

In a certain condition of loading the ship displacement is made up as follows:

Item	Mass (t)	KG (m)
Lightship	4060	6.0
Cargo	9040	7.0
Fuel	1200	1.2
Stores	200	8.0

Calculate:

(a) Actual KG (8 marks)

(b) Corrected righting lever, GZ_1 (6 marks)

(c) Plot a graph of corrected GZ_1 versus heeling angle (10 marks)

(d) Range of stability (1 mark)

END OF EXAMINATION PAPER

LIST OF FORMULAE

1. $WPA = \frac{1}{3} \times h \times Sum.of.PA \times 2$
2. $\delta T = \frac{trim}{LBP}\left[\frac{LBP}{2} \pm LCF\right]$
3. $Change\ in\ trim = \frac{TM}{MCTC}$
4. $Parallel\ rise\ or\ sinkage = w/TPC$
5. $Tan\theta = \frac{Listing\ moment}{\Delta \times GM}$
6. $GG_1 = (w \times d)/\Delta$
7. $Final\ KG = \frac{Final\ moment\ about\ keel}{Final\ displacement}$
8. $Final\ LCG = \frac{Final\ moment\ about\ amidships}{Final\ displacement}$
9. $TPC = \frac{\rho \times WPA}{100}$
10. $I_L = \frac{2}{3} \times h^3 \times Sum.of\ 2nd\ mmt\ area$
11. $I_T = \frac{2}{9} \times h \times Sum.of\ 2nd\ mmt\ area$
12. $BM_T = \frac{I_T}{\nabla}$
13. $BM_L = \frac{I_{LCF}}{\nabla}$
14. $I_{LCF} = I_L - WPA(LCF^2)$
15. $LCF = h \times \frac{Sum.of\ 1st\ mmt\ area}{Sum.of\ product\ area}$
16. $LCB = h \times \frac{Sum.of\ 1st\ mmt\ volume}{Sum.of\ product\ volume}$
17. $VCB = w \times \frac{Sum.of\ 1st\ mmt\ volume}{Sum.of\ product\ volume}$
18. $\nabla = \frac{1}{3} \times h \times Sum.of.PV$
19. $C_B = \frac{\nabla}{LBT}$
20. $C_P = \frac{\nabla}{A_M \times L}$
21. $C_M = \frac{A_M}{B \times T}$
22. $C_{WP} = \frac{A_W}{B \times L}$
23. $GZ = KN - KGsin\theta$