



**UNIVERSITI KUALA LUMPUR**  
**Malaysian Institute of Marine Engineering Technology**

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**FINAL EXAMINATION**  
**MARCH 2025 SEMESTER SESSION**

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<b>SUBJECT CODE</b>	<b>: LDD21402</b>
<b>SUBJECT TITLE</b>	<b>: NAVAL ARCHITECTURE 2</b>
<b>PROGRAMME NAME</b> (FOR MPU: PROGRAMME LEVEL)	<b>: DIPLOMA OF ENGINEERING TECHNOLOGY IN SHIP CONSTRUCTION AND MAINTENANCE</b>
<b>TIME / DURATION</b>	<b>: 09.00 AM - 11.30 AM</b> <b>(2 HOURS 30 MINUTES)</b>
<b>DATE</b>	<b>: 23 JUNE 2025</b>

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**INSTRUCTIONS TO CANDIDATES**

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1. Please read **CAREFULLY** 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 **TWO (2)** Sections, Section A and Section B.
4. Answer **ALL** question in Section A, and **TWO (2)** questions **ONLY** in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Formula is appended as reference.

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**THERE ARE 6 PAGES OF QUESTIONS, EXCLUDING THIS PAGE**

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**SECTION A (Total: 60 marks)****INSTRUCTION: Answer ALL questions.****Please use the answer booklet provided.****Question 1**

With reference to hydrostatic calculation.

A ship 96 m long and 20.8 m beam, floats at even keel draught of 4 m in sea water. Given that second moment of area about LCF,  $I_{LCF}$  is  $2.5 \times 10^5 \text{ m}^4$  and the centre of buoyancy is 2.65 m above the keel. Half Sectional areas up to the draught are as follows. Find for a draught of 4.0 m:

Station	0	1	2	3	4	5	6	7	8
$\frac{1}{2} A_s \text{ (m}^2\text{)}$	24.6	30.4	34.8	36.2	38.3	24.6	18.5	16.7	10.8

- (a) Volume of displacement (6 marks)  
 (b) Mass of displacement (2 marks)  
 (c) LCB from amidships (6 marks)  
 (d)  $BM_L$  (2 marks)  
 (e)  $KM_L$  (2 marks)  
 (f) Midship Area Coefficient (2 marks)

**Question 2**

With reference to the ship hydrostatics.

- (a) Briefly describe stiff and tender ships concerning the value of GM. (4 marks)  
 (b) Describe the action that needs to be taken to rectify the undesirable condition of stiff and tender ships. (4 marks)  
 (c) A ship is 65m long, 13m beam, floats at even keel draught of 5m in sea water. Sectional areas are as follows:

Station	0(AP)	1	2	3	4	5	6	7	8	9	10 (FP)
Area (m <sup>2</sup> )	11	26	36	44	48	49	48	43	35	20	5

Find;

- (a) Volume displacement (5 marks)  
 (b) Mass displacement,  $\Delta$  (2 marks)  
 (c) LCB from amidships (5 marks)

### Question 3

With reference to large angle stability.

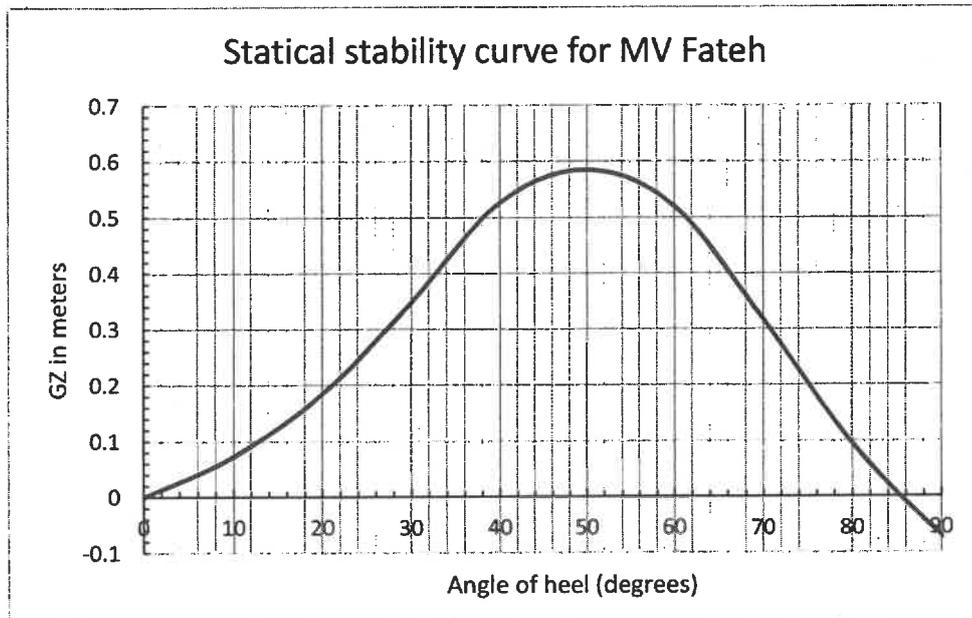


Figure 1: Curve for MV Fateh at 6000 tonnes displacement

Statical stability curve for MV Fateh at 6000 tonnes displacement is shown in Figure 1. From the above figure, determine:

- Range of stability. (2 marks)
- Initial GM,  $GM_0$ . (4 marks)
- GZ maximum. (2 marks)
- Angle of heel at GZ maximum. (2 marks)
- Angle of vanishing stability. (2 marks)
- 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  $\times \pi/180$ )

(8 marks)

**SECTION B (Total: 40 marks)****INSTRUCTION: Answer only TWO (2) questions.****Please use the answer booklet provided.****Question 4**

A ship of 4400 tonnes displacement has  $KM = 6.6$  m, and  $KG = 5.5$  m was listed 4.6 degrees to starboard. The following weights are then unloaded and loaded:

- Unload 440 tonnes cargo which centre of gravity is 6.1 m above the keel and 2.7 m to starboard from centre line.
- Load 95 tonnes of fuel oil which centre of gravity are 1.2 m above the keel and 1.1 m to port from centre line.
- Load 60 tonnes of ballast which centre of gravity is 1.6 m above the keel and 1.4 m to starboard from centre line.
- Unload 120 tonnes cargo which centre of gravity is 5.8 m above the keel and 5.4 m to port from centre line.

Find the final angle of list. (Assume no change in  $KM$ )

(20 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, $\theta$	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 (5 marks)
- (b) Corrected righting lever,  $GZ_1$  (6 marks)
- (c) Plot a graph of corrected  $GZ_1$  versus heeling angle (8 marks)
- (d) Range of stability (1 mark)

**Question 6**

A cargo ship has LBP 130 m, LCF 3 m aft of amidships and floats at 4.6 m and 4.2 m draught at FP and AP respectively. Its TPC is 22.6 tonnes while MCTC is 154 tonnes.m.

If the following items are loaded and unloaded:

UNLOADED	140 tonnes cargo from 50 m fwd of amidships
	90 tonnes cargo from 30 m aft of amidships
	80 tonnes cargo at amidships
LOADED	60 tonnes cargo at LCF
	70 tonnes fresh water at 25 m fwd of amidships

Calculate:

- (a) Parallel rise (2 marks)
- (b) Total change in trim (8 marks)
- (c) Change in trim fwd,  $\delta T_F$  (3 marks)
- (d) Change in trim aft,  $\delta T_A$  (3 marks)
- (e) Final draught at AP (2 marks)
- (f) Final draught at FP (2 marks)

## LIST OF FORMULAE

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

END OF EXAMINATION PAPER