CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JULY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMB32002**
SUBJECT TITLE	:	**NAVAL ARCHITECTURE 2**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF MARINE ENGINEERING TECHNOLOGY WITH HONOURS**
TIME / DURATION	:	**9.00 AM – 11.30 AM (2 HOURS 30 MINUTES)**
DATE	:	**15 DECEMBER 2025**

INSTRUCTIONS TO CANDIDATES

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. Answer **FOUR (4)** questions **ONLY**.
4. Please write your answers on the answer booklet provided.
5. Answer should be written in blue or black ink except for sketching, graphic and illustration.
6. Answer all questions in English language **ONLY**.
7. Formula is appended for your reference.

THERE ARE 6 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions only.

Please use the answer booklet provided.

Question 1

With reference to ship hydrostatic calculation.

A ship has the following waterplane area at draught 0 to 4.0 m in sea water.

Draught (m)	0	0.8	1.6	2.4	3.2	4.0
Waterplane Area (m^2)	50	500	750	1005	1250	1500

When the ship is floating at a draught of 4.8 m, the waterplane has the following offsets with LBP 120 m and 16 m beam.

St.	0	2	4	6	8	10	12	14	16	18	20
½ B (m)	6	7	8	8	9	9	9	7	6	5	4

Calculate for draught of 4.8 m:

(a) Waterplane Area, Aw (5 marks)

(b) Second moment of area about centerline, I_T (5 marks)

(c) Volume of displacement (6 marks)

(d) BM_T (2 marks)

(e) KB (5 marks)

(f) KM_T (2 marks)

Question 2

With reference to the effect of large changes of mass on trim calculation.

A ship LBP 120 m departed from Lumut Port with displacement 14,000 tonnes and longitudinal centre of gravity, (LCG) 1.2 m fwd of amidships.

The following items are now unloaded:

Item	Mass (t)	LCG from amidships (m)
Cargo	8600	0.5 m Aft
Fuel oil	400	55 m Fwd
Fresh water	120	6.5 m Aft
Stores	80	50 m Fwd

Hydrostatic particulars indicate that at 4800 tonne displacement, mean draught is 4.5 m, Moment to change trim 1 cm, (MCTC) 156 tonne.m, longitudinal centre of buoyancy, (LCB) 2.1 m aft of amidships and longitudinal centre of floatation, (LCF) 1.5 m fwd of amidships.

Calculate:

(a) New position longitudinal centre of gravity, LCG (8 marks)

(b) Total change in trim (5 marks)

(c) Change in trim Fwd, δT_F (3 marks)

(d) Change in trim Aft, δT_A (3 marks)

(e) Final draught at AP, T_A (3 marks)

(f) Final draught at FP, T_F (3 marks)

Question 3

With reference to the change in ship draught due to bilging at the end of compartment.

A box-shaped vessel 80 m x 12 m is floating upright in sea water on an even keel at 2.5 m draught. The forepeak tank which is 6 m long is empty as shown in Figure 3 below. If the vessel is now holed forward of the collision bulkhead, determine:

i.) Mass to be loaded (lost of buoyancy),w (2 marks)

ii.) TPC (2 marks)

iii.) Increase in mean draught (2 marks)

iv.) New mean draught (1 mark)

v.) Displacement (2 marks)

vi.) BM_L (2 marks)

vii.) MCTC (2 marks)

viii.) Total changes of trim (2 marks)

ix.) Changes of trim aft, δT_A (3 marks)

x.) Changes of trim fwd, δT_F (3 marks)

xi.) Final draught aft (2 marks)

xii.) Final draught fwd (2 marks)

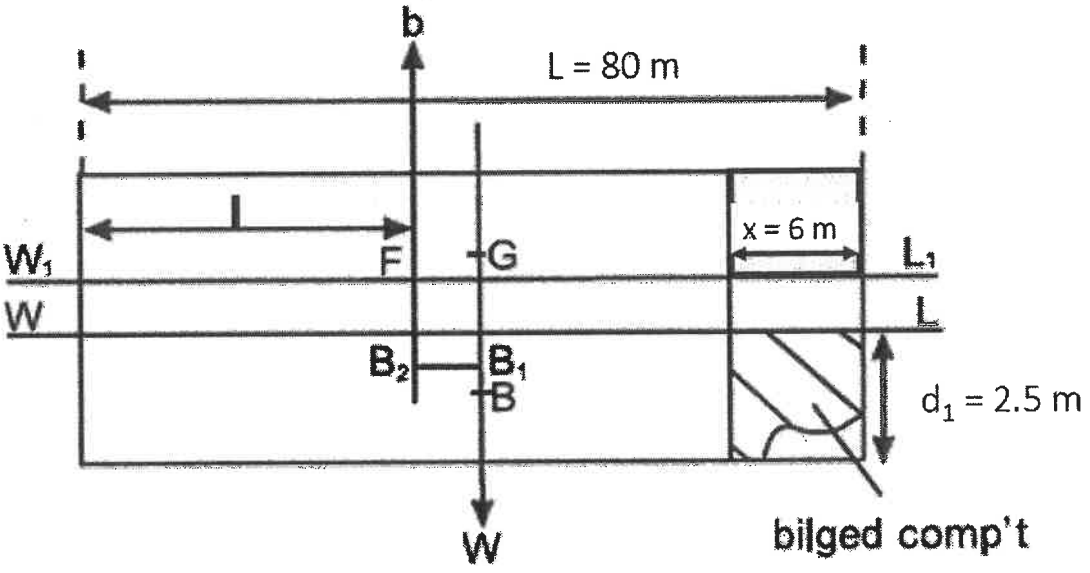

Figure 3

Question 4

With reference to the free surface effect on ship stability

(a) A vessel with 20,000 tonnes displacement, KM 9.0 m, KG 8.5 m, has a double bottom tank with partly full of sea water. Given that the tank surface is rectangular 30 m long and 12 m wide, calculate:

(i) Free surface moment, FSM (2 marks)

(ii) Free surface correction, FSC (2 marks)

(iii) GM_{SOLID} (2 marks)

(iv) GM_{FLUID} assuming no other tanks are slack (2 marks)

(b) Refer to Figure 4(b) below. A ship of 8000 tonnes displacement has KG = 4.7 m and KM = 5.5 m. A double bottom tank 30 m (L) x 12 m (B) x 2 m (D) is subdivided at the centerline and full of sea water ballast. The tank was then pumped out until half empty. Determine :

(i) Weight of ballast water to be pumped out (2 marks)

(ii) Changes height center of gravity, GG_1 (4 marks)

(iii) New height center of gravity, KG_1 (2 marks)

(iv) GM_{SOLID} (2 marks)

(v) Free surface moment, FSM (3 marks)

(vi) Free surface correction, FSC (2 marks)

(vii) GM_{FLUID} (2 marks)

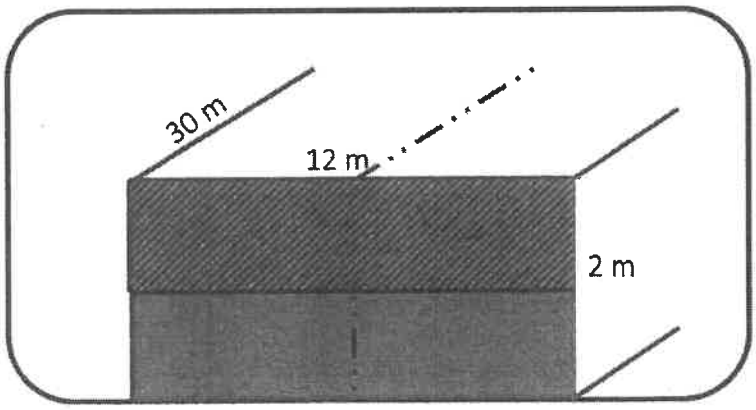

Figure 4(b)

Question 5

With reference to the ship large angle stability.

The heeling angle and the corresponding righting levers, GZ for a ship of 15000 tonnes displacement at an assumed KG of 6.816 m are as follows:

Heeling angle, θ	0	15	30	45	60	75	90
GZ, m	0	0.12	0.37	0.58	0.37	- 0.06	- 0.53

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

Item	Mass (t)	KG (m)
Lightship	4060	6.0
Cargo	9440	7.6
Fuel	1300	1.2
Stores	200	8.0

Based on the data given, calculate:

(a) Actual KG (6 marks)

(b) Corrected righting lever, G_1Z (6 marks)

(c) Plot a graph of corrected G_1Z versus heeling angle (8 marks)

(d) Range of stability (2 marks)

(e) The initial metacentric height GM_o (3 marks)

LIST OF FORMULAE

1) $Aw = (1/3 \times h \times \sum PA) \times 2$
2) $\delta T = trim \times \frac{(LBP/2 \pm LCF)}{LBP}$
3) $Volume = (1/3 \times h@w \times \sum PV)$
4) $BM_T = I_T / Volume$
5) $Final\ KG = \frac{Final\ Moment\ about\ Keel}{Final\ Displacement}$
6) i = Second moment of area = $(L \times B^3 / 12)$
7) $B_1M_L = I_L / Volume = (L_1{}^3B) / (12 \times Volume)$
8) $GG_1 = (w \times d) / \Delta$
9) Parallel sinkage/rise = w / TPC
10) $GM_{FLUID} = GM_{SOLID} - FSC$
11) $GM_L = KB_1 + B_1M_L - KG$
12) $MCTC = (\Delta \times BM_L) / (100L)$
13) $P = (MCTC \times t) / /$
14) Change in trim (bilging) = (w x d) / MCTC ; d = LBP/2
15) $G_1Z = GZ \pm GG_1 \sin \theta$
16) $FSC = FSM / \Delta$
17) $GG_1 = (P \times KG) / (\Delta - P)$
18) $Final\ LCG = \frac{Final\ Moment\ about\ amidships}{Final\ Displacement}$
19) $C_B = Volume / (L \times B \times T)$
20) Change in trim(m) = $(\Delta \times p) / (MCTC \times 100)$
21) $KB = (w \times \Sigma\ 1^{st}\ Moment) / (\Sigma\ PV)$
22) $FSM = i \times \rho \times 1/n^2$
23) $I_T = 1/9 \times h \times \Sigma\ 2^{nd}\ Moment_{(T)} \times 2$
24) $TPC = (Aw \times \rho) / 100$
25) $\delta T\ (bilging) = \frac{trim \times (LBP/2 \pm //2)}{LBP}$
26) $Tan\ \theta = \frac{listing\ moment}{\Delta \times GM}$
27) $Change\ in\ trim(cm) = \frac{w \times d}{MCTC}$

END OF EXAMINATION PAPER