CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 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	:	**2.00 PM – 4.30 PM (2 HOURS 30 MINUTES)**
DATE	:	**26 JUNE 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. Formular 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 2.5 m in sea water.

Draught (m)	0	0.5	1.0	1.5	2.0	2.5
Waterplane Area (m^2)	50	500	750	1005	1250	1500

When the ship is floating at a draught of 3.0 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 3.0 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 132 m departed from Lumut Port with displacement 16,000 tonnes and longitudinal centre of gravity, (LCG) 1.5 m fwd of amidships.

The following items are now unloaded:

Item	Mass (t)	LCG from amidships (m)
Cargo	9500	5.5 m fwd
Fuel oil	450	48 m aft
Stores	70	4.5 m fwd
Fresh water	180	10 m aft

Hydrostatic particulars indicate that at 5800 tonne displacement, mean draught is 4.5 m, Moment to change trim 1 cm, (MCTC) 129 tonne.m, longitudinal centre of buoyancy, (LCB) 0.52 m fwd of amidships and longitudinal centre of floatation, (LCF) 2.4 m aft 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 (3 marks)

(d) Change in trim aft (3 marks)

(e) Final draught at AP (3 marks)

(f) Final draught at FP (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)

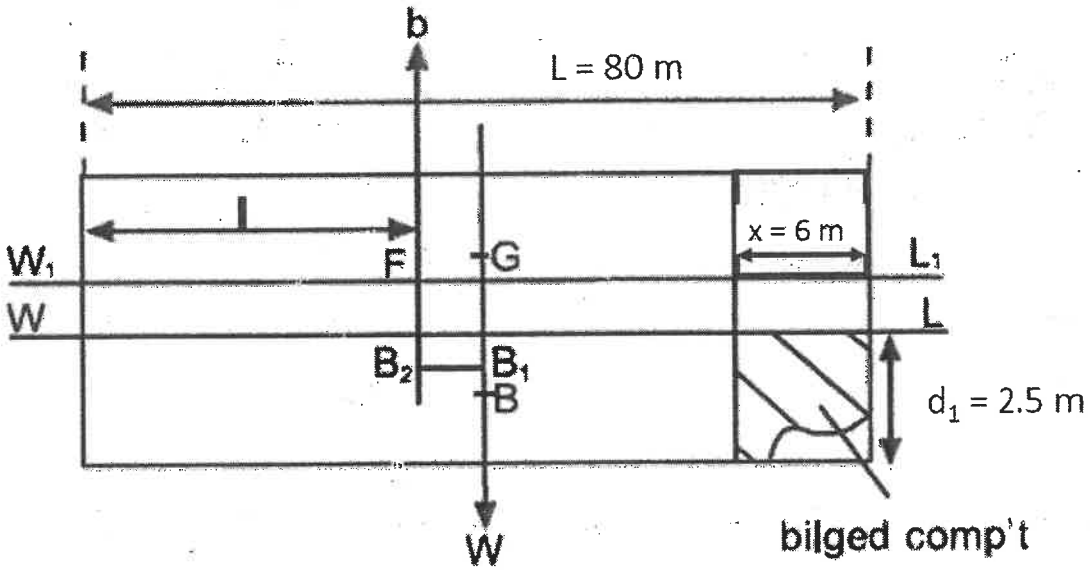

Figure 3

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 20 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) A ship of 8000 tonnes displacement has KG = 4.7 m and KM = 5.5 m. A double bottom tank 25m (L) x 10m (B) x 2m (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)

Question 5

With reference to the ship drydocking and grounding.

(a) A ship of 6000 tonnes displacement enters a dry dock trimmed 0.3 m by the stern. KM = 7.5 m, KG = 6.0 m, and MCTC = 90 tonnes m. The center of flotation is 45 m from aft. Determine the effective metacentric height at the critical instant before the ship takes the blocks overall by using :

i) Method 1: Shift in M (9 marks)

- Upthrust force, P
- Virtual loss of GM, MM_1
- New GM

ii) Method 2: Shift in G (6 marks)

- Virtual loss of GM, GG_1
- New GM

(b) A ship of 3000 tonnes displacement is 100 m long, has KM = 6.0 m, and KG = 5.5 m. The center of flotation is 2 m aft of amidships and MCTC = 40 tonnes m.
Determine the maximum trim for the ship to enter a dry dock **(by using method 1: Shift in M)** if the metacentric height at the critical instant before the ship takes the blocks forward and aft is to be not less than 0.3 m.

(10 marks)

i.) Virtual loss of GM,
ii.) Upthrust force, P
iii.) Maximum trim, t

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) $B_1M_L = I_L / Volume = (L_1^3 B) / (12 \times Volume)$
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) = $(w \times d) / MCTC$; $d = LBP/2$
15) $MM_1 = (P \times KM) / \Delta$
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) = $(\Delta \times \rho) / (MCTC \times 100)$
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