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

## FINAL EXAMINATION

## FEBRUARY 2025 SEMESTER SESSION

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|---|---|
| **SUBJECT CODE** | : **LMB21803** |
| **SUBJECT TITLE** | : **NAVAL ARCHITECTURE FOR MARINE ENGINEERING SYSTEM** |
| **PROGRAMME NAME**<br>(FOR MPU: PROGRAMME LEVEL) | : **BACHELOR OF MARINE ENGINEERING TECHNOLOGY WITH HONOURS** |
| **TIME / DURATION** | : **9.00 AM – 11.30 AM**<br>**(2 HOURS 30 MINUTES)** |
| **DATE** | : **23 JUNE 2025** |

## 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 TWO (2) sections; Section A and Section B.

4. Answer ALL questions in Section A. For Section B, answer THREE (3) questions ONLY.

5. Please write your answers on the answer booklet provided.

6. Answer all questions in English language only.

THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

**SECTION A (Total: 40 marks)**

**INSTRUCTION: Answer ALL questions.**
**Please use the answer booklet provided.**

**Question 1**

With reference to ship dimension and form.

(a)     Sketch profile view and labels the following ship terminologies.
    i.)   After Perpendicular (AP)
    ii.)  Forward Perpendicular (FP)
    iii.) Amidships
    iv.)  Length Between Perpendiculars (LBP)
    v.)   Length Overall (LOA)

(8 marks)

(b)     Sketch front view and labels the following ship terminologies.
    i)    Breadth
    ii)   Draught
    iii)  Freeboard
    iv)   Depth
    v)    Centreline (CL)
    vi)   Camber
    vii)  Rise of floor
    viii) Tumble home
    ix)   Flat of keel

(12 marks)

## Question 2

With reference to the sagging and hogging stress onboard ships that are caused by the sea state.

(a)     Describe sagging stress condition and indicate the area in a ship that will be affected by the maximum tensile and compressive stress.

(5 marks)

(b)     Sketch and labels sagging stress condition.

(5 marks)

(c)     Describe hogging stress condition and indicate the area in a ship that will be affected by the maximum tensile and compressive stress.

(5 marks)

(d)     Sketch and labels hogging stress condition.

(5 marks)

**SECTION B (Total: 60 marks)**

**INSTRUCTION: Answer only THREE (3) questions.**
**Please use the answer booklet provided.**

**Question 3**

With reference to ship hydrostatic calculation.

(a)     A ship with a 60 m LBP is floating in sea water at a draught of 5 m. The waterplane has the following offsets:

| Station | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------|---|---|---|---|---|---|---|---|---|---|----|
| ½ B (m) | 4 | 4 | 5 | 7 | 8 | 8 | 7 | 6 | 5 | 2 | 1 |

Calculate for draught of 5.0 m.

i)   Waterplane area, Aw                                    (5 marks)
ii)  LCF from amidships                                     (5 marks)

(b)     A ship with a 60 m LBP is floating in sea water has the following waterplane area up to 3 m draught:

| Draught(m) | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
|------------|---|-----|---|-----|---|-----|---|
| Aw (m²) | 210 | 340 | 560 | 680 | 760 | 800 | 840 |

Calculate for draught of 3.0 m:

i)   Volume of Displacement                                 (5 marks)
ii)  KB                                                     (5 marks)

**Question 4**

With reference to the ship form coefficient and dock water allowance.

(a) A ship with 16.0 m beam and displacement of 8000 tonnes is floating at a draught of 5.8 m in sea water. Its waterplane area coefficient is 0.86, prismatic coefficient is 0.89 and TPC is 14.0 tonnes. Calculate for a draught of 5.8 m:

| | | |
|---|---|---|
| i.) | Waterplane Area, $A_W$ | (2 marks) |
| ii.) | LBP of the ship | (2 marks) |
| iii.) | Volume of displacement | (2 marks) |
| iv.) | Area of immersed midship section, $A_M$ | (2 marks) |
| v.) | Midship section area coefficient, $C_M$ | (2 marks) |
| vi.) | Mass to be unloaded to decrease the draught to 5.60 m. | (3 marks) |

(b) A ship is floating at 6.0 m mean draught in dock water of density 1005 kg/m³ as shown in Figure 4(b) below. TPC is 10 tonnes and FWA is 150 mm. The maximum permissible draught at sea water is 6.1 m.

Determine :

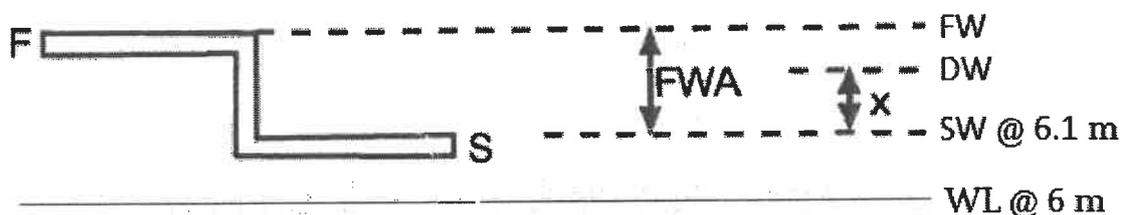| | | |
|---|---|---|
| i.) | Dock Water Allowance, DWA | (2 marks) |
| ii.) | Maximum permissible draught at dock water | (1 mark) |
| iii.) | Draught to be increased so that it will float at maximum permissible at dock water | (2 marks) |
| iv.) | Weight to be loaded to meet the maximum permissible draught at dock water | (2 marks) |



Figure 4(b)

**Question 5**

With reference to the ship angle of list calculation.

(a) A ship of 6000 tonnes displacement has KM = 7.3 m, and KG = 6.9 m, is floating at 5° listed to port. If the ship is to achieve an upright condition by using ballast water from Water Ballast Tank No.5 , determine:

    i) The required changes angle.:                         (2 marks)

    ii) The required listing moment.                            (4 marks)

    iii) The weight of ballast water to be transferred given center gravity for both tank of port and starboard are 3 m out from centerline. State also movement of ballast water must take place.     (4 marks)

(b) A ship of 8000 tonnes displacement is listed 4° to starboard and has GM 0.68 m. A weight of 80 tonnes, already onboard is moved 1.7 m vertically upwards and 8.5 m transversely to port. Determine:

    i) New GM                                    (4 marks)

    ii) Changes angle of list                             (4 marks)

    iii) Final angle of list                                (2 marks)

## Question 6

With reference to the effect of large changes of mass on ship 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                (7 marks)

(b) Total change in trim                       (3 marks)

(c) Change in trim Fwd                       (3 marks)

(d) Change in trim Aft                        (3 marks)

(e) Final draught at AP                       (2 marks)

(f) Final draught at FP                       (2 marks)

## LIST OF FORMULAE

1) $A_W = (1/3 \times h \times \sum PA) \times 2$

2) $\delta T = trim \times \left[ \dfrac{LBP/2 \pm LCF}{LBP} \right]$

3) $C_W = A_W / (L \times B)$

4) $Change\ in\ trim(m) = \dfrac{\Delta \times p}{MCTC \times 100}$

5) $Volume = (1/3 \times h@w \times \sum PV)$

6) $Final\ KG = \dfrac{Final\ Moment\ about\ Keel}{Final\ Displacement}$

7) $C_P = Volume / (A_M \times L)$

8) $FWA(mm) = \Delta / (4 \times TPC)$

9) $GG_1 = (w \times d) / \Delta$

10) $BM_L = I_{LCF} / Volume$

11) $MCTC = (\Delta \times G_{ML}) / 100L$

12) $Parallel\ sinkage/rise = w / TPC$

13) $Final\ LCG = \dfrac{Final\ Moment\ about\ amidships}{Final\ Displacement}$

14) $C_B = Volume / (L \times B \times T)$

15) $I_{LCF} = I_L - Ay^2$ ; $A = A_W, y = LCF$

16) $KB = \dfrac{w \times \sum 1^{st} Moment}{\sum PV}$

17) $DWA(mm) = FWA (1025 - \rho_{DW}) / 25$

18) $TPC = (A_W \times \rho) / 100$

19) $Change\ in\ trim(cm) = \dfrac{trimming\ moment\ (w \times d)}{MCTC}$

20) $C_M = A_M / (B \times T)$

21) $LCF = \dfrac{h \times \sum 1^{st} Moment}{\sum PA}$

22) $Tan\ \theta = \dfrac{listing\ moment}{\Delta \times GM}$

## END OF EXAMINATION PAPER