UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

OCTOBER 2025 SEMESTER SESSION

SUBJECT CODE	:	**LND20103**
SUBJECT TITLE	:	**NAVAL ARCHITECTURE 2**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN SHIP DESIGN**
TIME / DURATION	:	**09.00 AM - 11.30 AM (2 HOURS 30 MINUTES)**
DATE	:	**29 JANUARY 2026**

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. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** multiple-choice questions in Section A. For Section B, answer **THREE (3)** question **ONLY**.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Please refer to the attached formula.

THERE ARE 13 PAGES OF QUESTIONS, EXCLUDING THIS COVER PAGE.

SECTION A (25 MARKS)

INSTRUCTION: Answer ALL Questions
Please use the objective answer sheet provided

1. For a rectangular box shaped vessel, when a weight is added on to one side the vessel would list to that side. This is what we call trim. Trim can be known as answer below except for.

Select one:

a. Measured as the difference between the draft forward and aft

b. The distance between lengths of waterline until the keel line

c. Also known as 'longitudinal stability'

d. If forward draft is greater than aft draft it is called a trimming by bow

2. Why vessel trim?

Select one:

a. The changes in density of water such as from salt water to fresh water and vice versa

b. The effect of the sea state

c. The ship is involved in an accident with another ships

d. The determination of stability of the ship is not accurate

3. The vessel will trim if the cargoes are loading to the vessel. Which location will not affect the trim of the ship if the cargoes are loading on that particular location?

Select one:

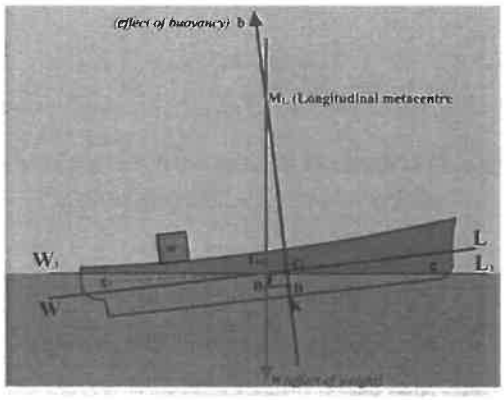
a. At the center of flotations of the ship (LCF)

b. At the center of gravity of the ship (LCG)

c. At the forward of the ship

d. At the center of buoyancy of the ship (LCB)

4. There is two type of trim. Please define which type of trim for the vessel in the picture?



Select one:

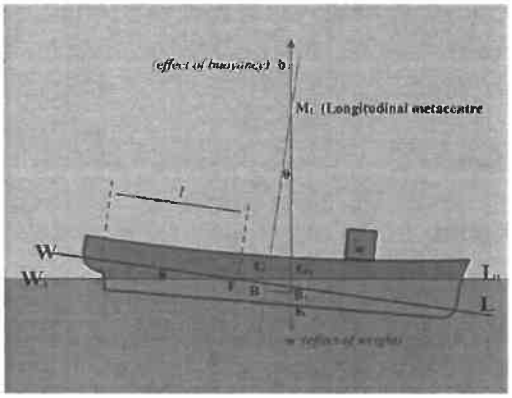
a. Trimming by draft

b. Trimming by amidship

c. Trimming by bow

d. Trimming by stern

5. Please find the vessel in the picture are experienced the trimming by?



Select one:

a. Trimming by bow

b. Trimming by forward perpendicular

c. Trimming by amidship

d. Trimming by stern

6. The trim is defined as the difference in drafts aft and forward. Which one is the formula for the differences of draft aft and forward for trimming by bow?

Select one:

a. t=AP-FP

b. $t=T_A-T_F$

c. $t=T_F-T_A$

d. t=FP-AP

7. Define the term longitudinal centre of flotation (LCF)?

Select one:

a. distance of centre of flotation from amidships

b. centre of flotation and distance measured from the forward perpendicular

c. distance of centre of flotation of the ship between perpendiculars

d. distance of centre of flotation from aft perpendicular

8. **State w**hat is the longitudinal BM (BM_L)?

Select one:

a. Distance between the centre of gravity G and the longitudinal metacentre M

b. Longitudinal BM is large when compared to KG

c. Distance of the longitudinal moment of inertia of the water-plane about a transverse axis passing through the LCF

d. Distance between the centre of buoyancy and the longitudinal metacentre ship

9. GM can be define as GM = KB + BM – KG. what is GM_L ?

Select one:

a. distance between the centre of buoyancy and the longitudinal metacentre ship

b. distance between the centre of gravity G and the longitudinal metacentre M

c. the moment of inertia about a transverse axis passing through amidships

d. distance between the LCF and amidships

10. Select from the list of formula below which cannot be used to calculate Moment to change trim 1cm (MCT1cm) ?

a. MCT 1 cm = (W x GM_L)/100L

b. MCT 1 cm = 7 T^2 / B

c. MCT 1 cm = (I/L) x Change of trim

d. MCT 1 cm = 7 TPC^2 / B

11. Calculate the trimming moment of the ship if a weight 120 ton already on board is shifted forward a distance of 45 m. Trimming moment = w x d

Select one:

a. 5400 ton m by the back

b. 5400 ton m by the amidship

c. 5400 ton m by the head

d. 5400 ton m by the volume

12. Please find value of the change of trim for the ship if the trimming moment is 5400 tonne by the head and MCT 1 cm = 240 ton.m

Select one:

a. 23.5 cm by the head

b. 22.5 cm by the head

c. 22 cm by the head

d. 20.5 cm by the head

13. If the change of draft aft is 10.7 cm and the change of trim is 22.5 cm, please find the value of change of draft forward?

Select one:

a. 33.2 cm

b. 11.8 cm

c. 2.10 cm

d. .475 cm

14. Calculate the new drafts if a weight 120 ton already on board is shifted forward a distance of 45 m

Original draft *6.500 m Aft* *5.500 m Forward*

Change due trim *0.107 m* *0.118 m*

Select one:

a. 5.500 m Aft 6.500 m Forward

b. 5.618 m Aft 6.393 m Forward

c. 6.500 m Aft 5.500 m Forward

d. 6.393 m Aft 5.618 m Forward

15. A ship 90 m long is floating at drafts 4.5 m F and 5.0 m A. The centre of flotation is 1.5 m aft of amidships. TPC 10 tons. MCT 1 cm is 120 ton m. The total weight of 450 tons is loaded in a position 14 m forward of amidships. Find the sinkage of the ship?

Select one:

a. 45 m

b. 45 mm

c. 45 tonne

d. 45 cm

16. Changes of trim may be caused by this except for?

Select one:

a. Bilging or ballasting

b. Moving weights already on board in a fore – aft direction

c. Changes in density of water, i.e. SW to FW or FW to SW

d. Adding weight to the ship at a position of the LCF

17. A ship floating at equal draft all along is said to be on an even keel or known as?

Select one:

a. trimming by stern

b. trimming by draft

c. zero trim

d. trimming by aft

18. The longitudinal metacentric height GML is the distance between the centre of gravity G and the longitudinal metacentre M. The formula to find the GM is?

Select one:

a. GM = KB + KG – BM

b. GM = KG + BM – KB

c. GM = KM + BM – KG

d. GM = KB + BM – KG

19. The displacement of a layer of water 1 cm thick can be used to calculate the change in draft at the LCF when there is a significant change in vessel displacement. How it can be found?

Select one:

a. Stability Book

b. Hydrostatic graph

c. Naval architecture book

d. Calculation of Moment to change trim 1cm (MCT1cm)

20. The half-breadths, in metres, of the load waterplane of a ship 100m long, numbered from aft, are as follows:

STATIONS	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
½ B	0	5.00	6.00	6.10	6.10	6.02	5.38	3.68	0

If the displacement in salt water is 4500*t*, find the area of the waterplane, the position of F, and the value of BM_L.

L_{BP} = 100m Δ_{sw} = 4500t

What is the distance between stations?

a. 13.5 m

b. 11.1 m

c. 12.5 m

d. 12.8 m

21. Select from the list below which of the following best describes "trim" of a ship?

a. The ability of a ship to return to an upright position after heeling

b. The difference between the draft at the bow and the draft at the stern

c. The change in displacement due to added cargo

d. The percentage of stability based on the metacentric point

22. Determine the most likely effect when cargo is shifted towards the forward part of the ship?

a. The ship will sit deeper at the stern

b. The ship will float higher overall

c. The ship will sit deeper at the bow

d. The ship will lose all stability

23. State the primary role of the Longitudinal Centre of Buoyancy (LCB) in trim analysis?

a. To determine the total amount of water displaced by the ship

b. To indicate the ship's transverse (side-to-side) stability

c. To evaluate the relationship between displacement and metacentric height

d. To identify the point where buoyant force acts longitudinally

24. If the *Metacentric Height (GM)* is small but still positive, what is the best interpretation of the ship's stability?

a. The ship is highly stable and heels back quickly

b. The ship is unstable and will capsize

c. The ship is stable but tends to have slow rolling motion

d. The ship is fully stable without any risk

25. Explain the effect of adding cargo on the upper deck that reduce the ship's initial stability? Select one.

a. It reduces the LCB and increases bow trim

b. It lowers KG and increases GM

c. It raises KG and decreases GM

d. It reduces ship weight and increases buoyancy

SECTION B (Total: 75 marks)

INSTRUCTION: Answer only THREE (3) 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

Calculate 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. Calculate 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.

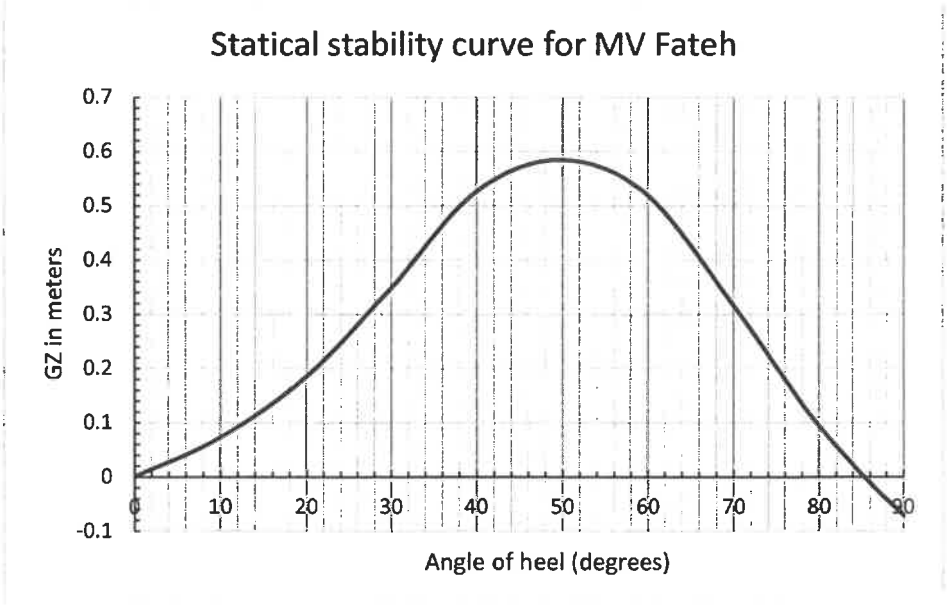


Figure 1: Curve for MV Fateh at 5500 tonnes displacement

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 **conversion;** $[1deg = \frac{\pi}{180} radian]$

(15 marks)

Question 4

With reference to angle of list calculation.

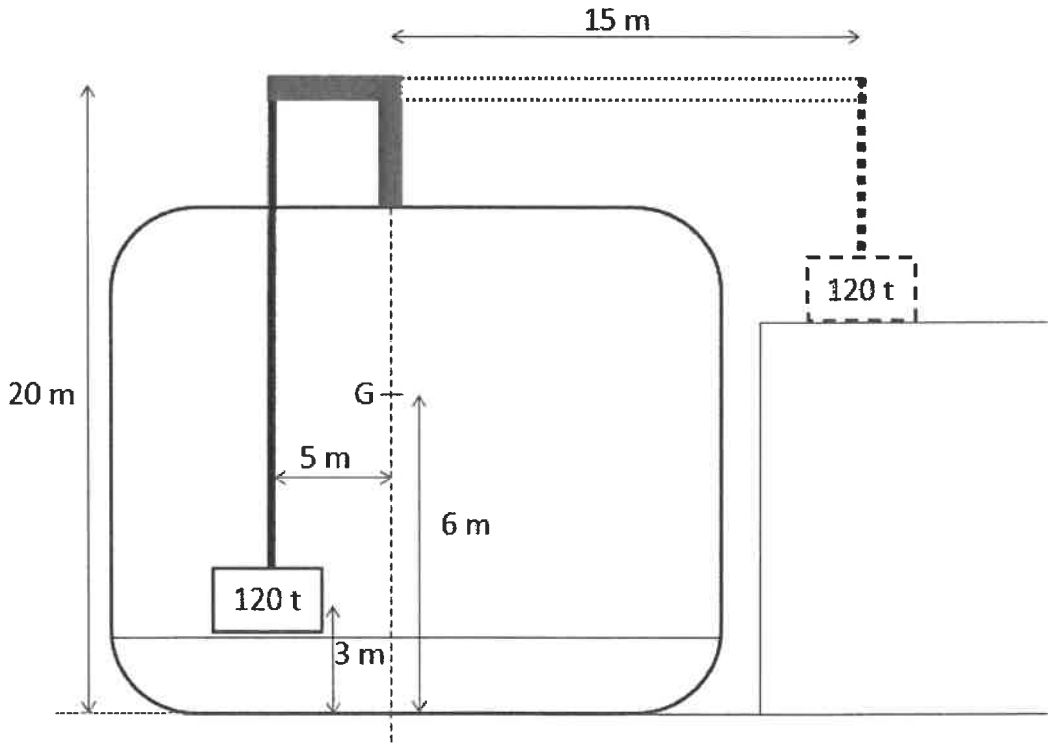
A ship of 9000 tonnes displacement has KM 7.6 m, KG 6 m is listed 5° port. She has to be discharged a weight of 120 tonnes from No 3 Lower Hold using her jumbo derrick whose head is 20 m above the keel and located at centre line. Given centre of gravity of the weight is 3 m above the keel and 5 m to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



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. $GZ = KN - KGsin\theta$