UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JANUARY 2016

SUBJECT CODE	:	LMB 20303
SUBJECT TITLE	:	SHIP CONSTRUCTION
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00 am – 12.00 pm (3 HOURS)
DATE	:	25 MAY 2016

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. Answer FIVE (5) questions only.
6. Answer all questions in English.

THERE ARE 8 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.

Question 1

(a) A box-shaped barge of uniform construction is 32 m long and displaces 352 tonnes when empty, is divided by bulkheads into four equal compartments.

Cargo is loaded into each compartment and levels as follows:

No. 1 hold	192 tonnes	No. 2 hold	224 tonnes
No. 3 hold	272 tonnes	No. 4 hold	176 tonnes

Construct load shearing force diagrams before calculating the bending moment at the and at the position of maximum value; hence draw the bending moment diagram. Use the graph paper given.

(10 Marks)

(b) The LBP of the ship is 180 m and the beam is 28 m and block coefficient 0.75. The hull weight is 5000 tonnes having LCG 25.5 m from amidships. The mean LCB is 25 m from amidships. Values of the constant b are: hogging 9.795 and sagging 11.02. By using Murray's Method, please calculate the longitudinal bending moments amidships for the ship on a standard wave with the crest amidships and the through amidships. The data for the ship are as follows:

Item	Weight (tonnes)	LCG from amidships
Hold No. 1	1800	55.0 m aft
Hold No. 2	3200	25.5 m fwd
Hold No. 3	1200	5.5 m fwd
Hold No. 4	2200	24.0 m aft
Hold No. 5	1500	50.0 m aft
Machinery	1500	7.5 m aft
Fuel Oil	400	8.0 m aft
Fresh Water	150	10.0 m fwd

Table 1

(10 marks)

Question 2

(a) From your understanding on the basic stress and strain in ship structures, explain these basic stress and strain and show their relationship mathematically.

(5 marks)

(b) Figure 1 shows a section of a sand carrying barge of dimension as shown. If barge is subjected to a bending moment at the particular section is 1000 MNm, calculate the second moment of area, the position of neutral axis and the stress on the keel and the main deck. The superstructure thickness is 12 mm all around, the main deck is 16 mm, the bottom is 20 mm and the sides are 18 mm thick.

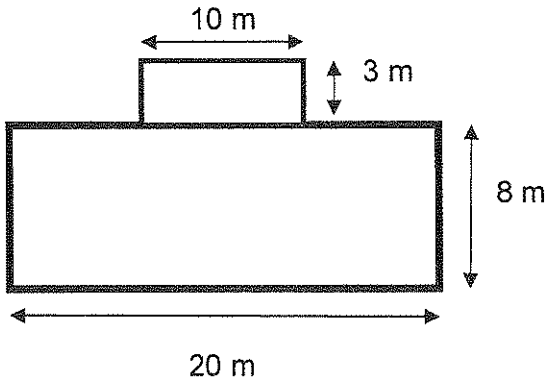


Figure 1

(15 marks)

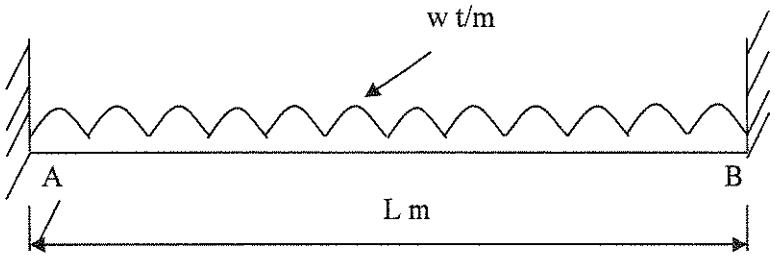
SECTION B (Total: 40 marks)
INSTRUCTION: Answer only THREE (3) questions

Question 3

a) A combined deck plating and a transverse beam of length L m of grain carrying ship cargo hold designed to carry a uniformly distributed load w t/m can be represented by a structure loaded as shown in Figure 2. Both ends are assumed to be fully welded (i.e fixed ends). Derive the expression of the generalized bending moment of the beam, at a distance x from one end beyond the mid length of the beam, given that the fixing moments at both ends are equal to $wL^2/12$

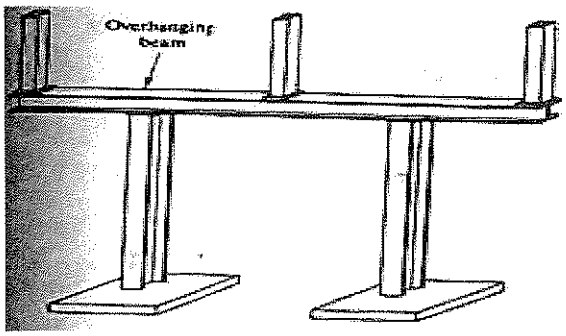
(10 marks)

Figure 2

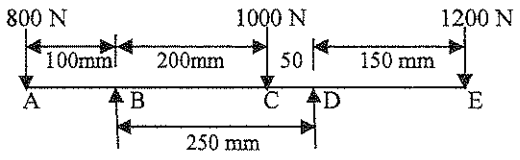


b)

Figure 3



A figure 3 shown that a structure of overhanging beam and the free body diagram of the structure can be illustrated as follows:



Calculate the reaction for the overhanging beam shown above at point B and C.

(10 marks)

Question 4

a) Prove the following expression to demonstrate your fundamental on the principle of bending theory use in solving longitudinal strength of ships by mathematically.

$$M / I = \sigma / y = E / R$$

Where ;

M – Bending Moment
I – Second moment of area of cross-section
σ - bending stress
y – distance from neutral axis
E – Young's modulus
R – Radius of curvature

(10 marks)

b) A ship sails through a rough weather at sea is subjected to a bending moment of 100 tm and the ship rolls to one side by Ø degrees.

i. Derive the general expression of the stress subjected to the structure at a coordinate (x,y) as the ship rolls to Ø degrees.

(5 marks)

ii. Calculate the stress subjected to the ship at a coordinate position of 10 m from the ship's centerline and 15 m from the inclined neutral axis on the midships section as the ship rolls to 30 degrees, given that the second moment of areas about the neutral axis (I_{NA}) is 350m^4 and about the ship vertical centerline (I_{CL}) is 200 m^4 and the midships bending moment is 310 MNm.

(5 marks)

Question 5

i) Refer to figure 4 below. List the components of ship highlighted :

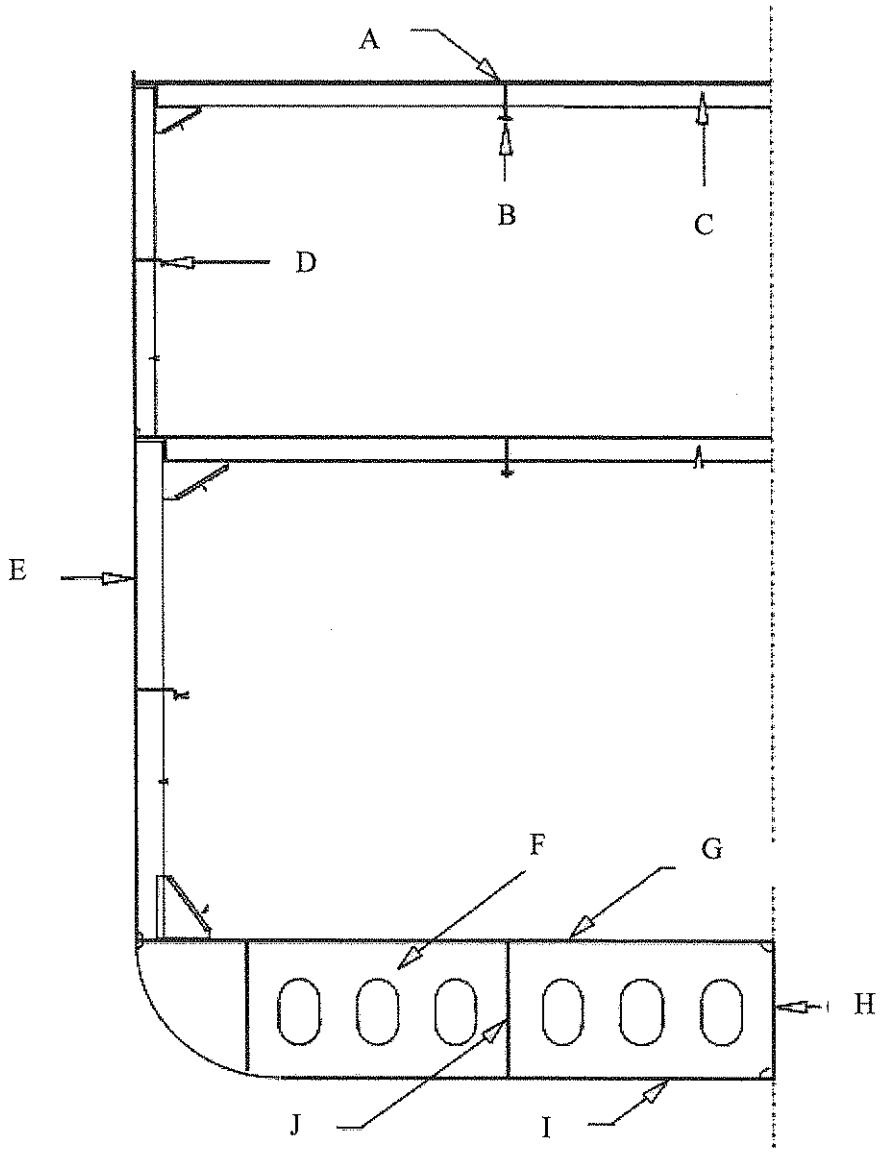


Figure 4

(5 marks)

ii) Refer to the figure 5 below :

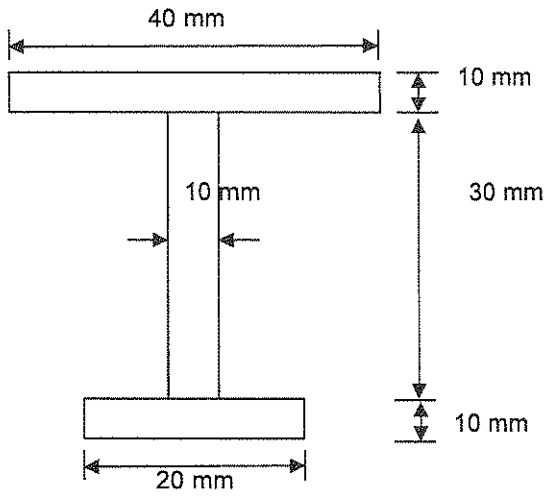


Figure 5

The beam above (figure 2) is to be used as a deck girder for box-shaped barge. Please calculate;

a) The True Neutral Axis

b) The Moment of Inertia about the Neutral Axis

(15 Marks)

Question 6

(a) Theorem of Castigliano states that the partial derivative of the total strain energy U with respect to each applied load is equal to the displacement of the structure at the point of application in the direction of the load. The theorem could be applied in solving problems on ship structures.

i. Write down the expression of the strain energy due to bending moment M for a curved beam of second moment area I and the Young's modulus E.

(5 marks)

ii. Derive the equation of the displacement from the expression in (i) above.

(5 marks)

(b) A continuous beam ABC (figure 6) of constant cross section is fixed in position and direction at point A and C, and simply supported at point B. The beam is loaded as shown below:

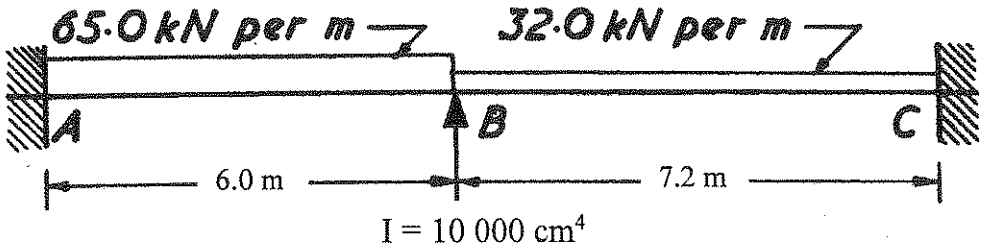


Figure 6

Please analysis and determine the final bending moments at point A, B and C by using Moment Distribution Method and sketch the Bending Moment Diagram to show the distribution of moments along the beam.

(10 marks)

END OF QUESTION

List of Formula :

Strain Energy Method:

Loading Type	Strain Energy Constant Variables	Strain Energy General Case
Axial	$U = \frac{F^2 l}{2EA}$	$U = \int_0^l \frac{F^2 dx}{2EA}$
Bending	$U = \frac{M^2 l}{2E I}$	$U = \int_0^l \frac{M^2 dx}{2EI}$
Torsion	$U = \frac{T^2 l}{2GJ}$	$U = \int_0^l \frac{T^2 dx}{2GJ}$
Direct Shear	$U = \frac{F^2 l}{2AG}$	$U = \int_0^l \frac{F^2 dx}{2AG}$
Traverse Shear	$U = \frac{K V^2 l}{2GA}$	$U = \int_0^l \frac{KV^2 dx}{2GA}$

Moment Distribution Method:

1st Principle : $$M_{AB} = \frac{1}{2} M_{BA}$$

2nd Principle $$M_{BA} = 4E \tan\theta \frac{I}{L}$$

3rd Principle $$M_{BA} = 3E\theta \frac{I}{L}$$

4th Principle $$M_{AB} = M_{BA} = \frac{6EId}{L^2}$$

5th Principle $$M_{BA} = \frac{3EId}{L^2} = \frac{6EId}{2L^2}$$