[OCD26]

UNIVERSITY OF BOLTON

WESTERN INTERNATIONAL COLLEGE FZE

BEng (HONS) CIVIL ENGINEERING

SEMESTER ONE EXAMINATION 2018/2019

MATHEMATICS AND STRUCTURAL ANALYSIS

MODULE NO: CIE4011

Date: **Tuesday 8th January 2019** **Time: 10.00am – 1.00pm**

INSTRUCTIONS TO CANDIDATES:

There are five questions on this paper

Answer ALL questions.

Answer Section A and Section B questions in separate answer books.

Marks for parts of questions are shown in brackets.

This examination paper carries a total of 100 marks.

Formula sheet for Section B is attached on Page 8 of this paper

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

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SECTION A: STRUCTURAL ANALYSIS

Question 1

Figure Q1(a) on page 3 shows a 8m long simply supported beam**.** The beam is pinned at A, and at D it is supported by a roller support. The beam carries point load 5kN acting vertically downward at B, point load 2kN acting vertically downward at C together with a UDL of 3kN/m acting vertically downward between B and C. The beam has an asymmetrical I-shape cross-section as shown in **Figure Q1(c) on page 3**.

(a) Determine the position of the Neutral Axis

(5 marks)

(b) Determine the value of the second moment of area about the neutral axis of the beam section

(5 marks)

(c) With the help of the Shear force diagram of the given beam, shown in **Figure Q1(b) on page 3**, draw a neat hand drawn diagram of the Bending Moment (BMD), indicating the values of bending moment at A, B, C and D. Also determine the maximum Bending moment.

(9 marks)

(d) Compute the maximum bending stress developed in the beam and sketch the stress variation along the beam depth, clearly indicating regions of tension and compression.

(5 marks)

(e) Find the maximum compressive stress due to pure compression and bending for the column of dimension 300 X 400 mm if an eccentric load of 1300kN acts at a distance of 100mm from the centroid of the column as shown in **Figure Q1(d) on page 4.**

(6 marks)

NOTE:

The moment of Inertia of Unsymmetrical section is given by $I = I_o + Ah^2$

The bending moment equation is given by $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$

Total 30 marks

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Question 1 continued over to the next page
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Question 1 continued

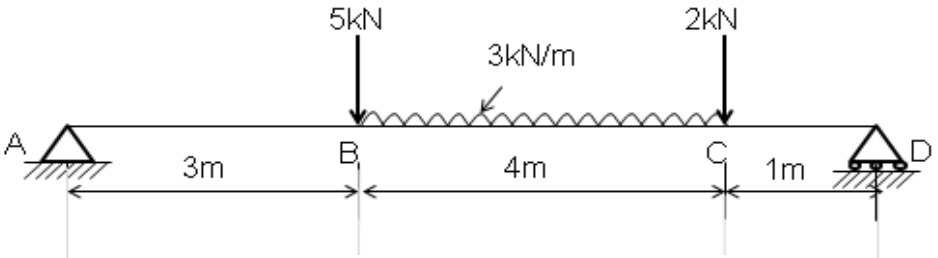

Figure Q1(a) : Simply supported beam

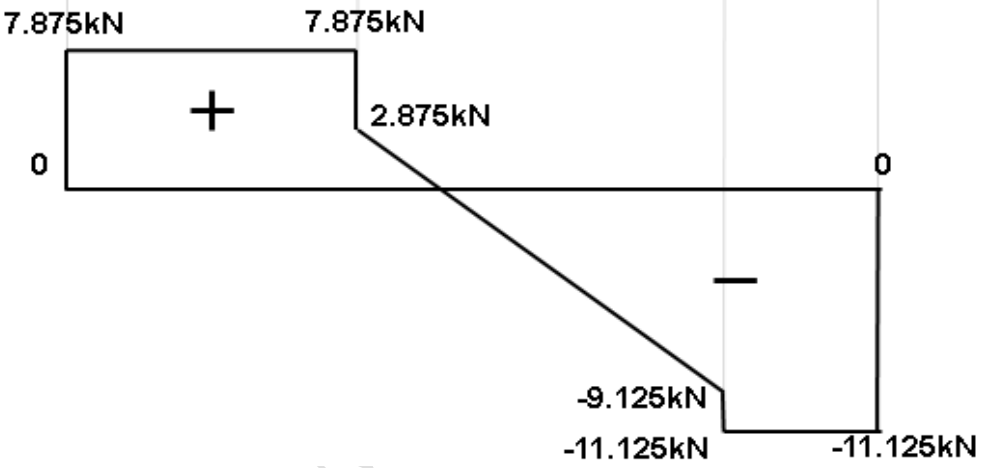

Figure Q1(b) : Shear Force Diagram (SFD) in kN

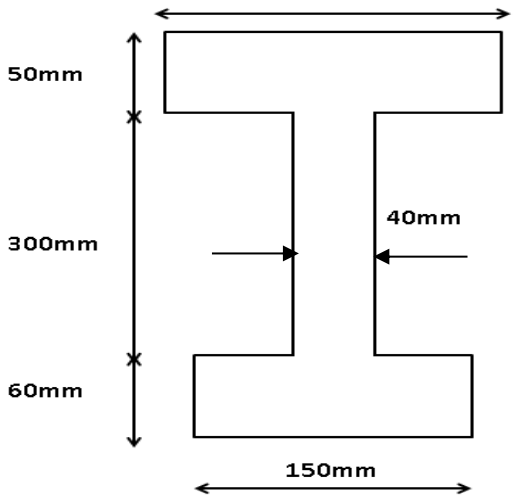

Figure Q1©: Cross section of the beam

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Question 1 continued

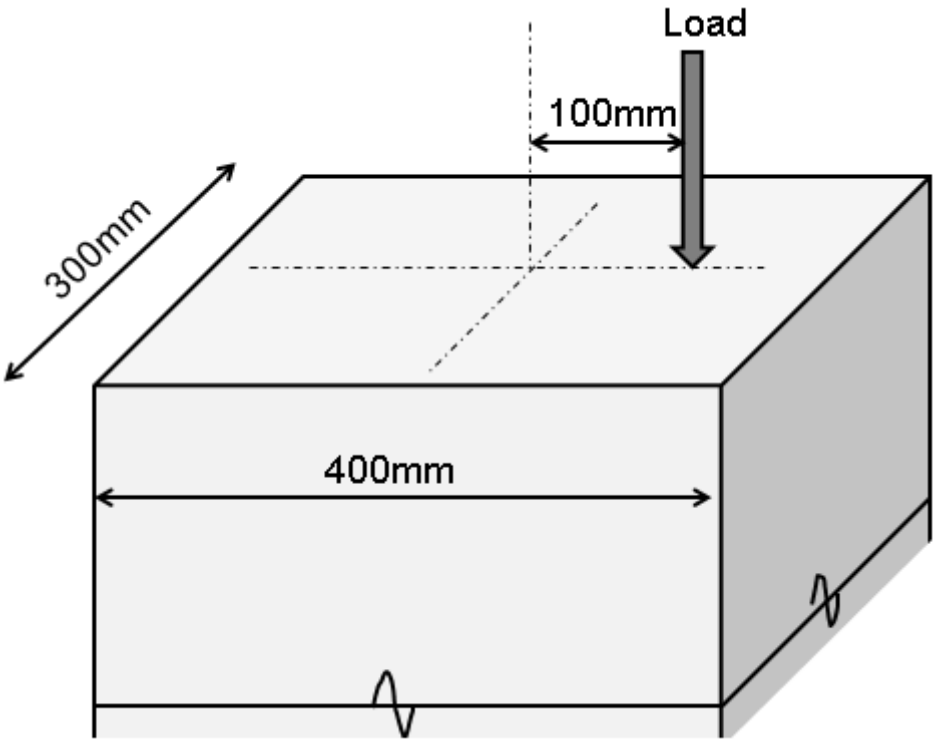

Figure Q1(d)

Question 2

Figure Q2 on page 5 shows a pin jointed truss. The truss has a pin support at A and a roller support at E. The truss is subjected to two vertical loads, 15kN at B and 30kN at C.

(a) Determine the values of the support reactions

(4 marks)

(b) Using Joint method analysis, determine the value and type of force in each element of the truss.

(12 marks)

(c) Summarise your answer on a diagram of the truss layout.

(4 marks)

Total 20 marks

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Question 2 continued over to the next page
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Question 2 continued

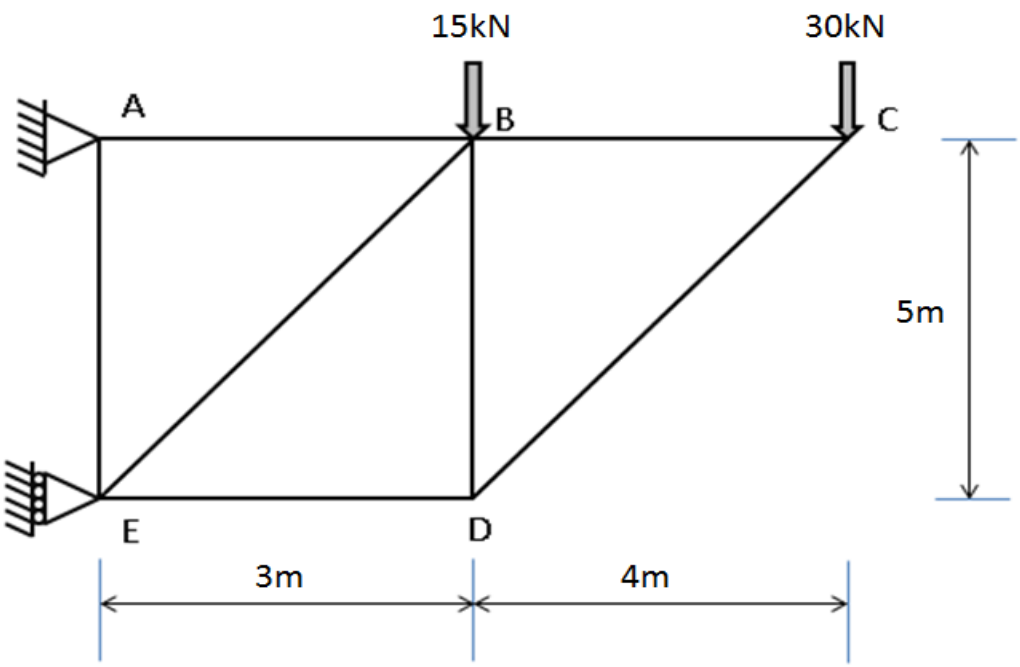

Figure Q2 : Truss Layout

END OF SECTION A

Please turn over for Section B

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SECTION B: MATHEMATICS

Question 3

a. Transform the formula T = $2\pi\sqrt{\frac{L}{g}}$ to make L the subject

(2 marks)

b. Given that $\frac{D}{d} = \sqrt{\frac{f+p}{f-p}}$, express p in terms of D, d and f

(4 marks)

c. Simplify $\frac{(a^3 b^{\frac{1}{2}} c^{\frac{-1}{2}})(ab)^{\frac{1}{3}}}{(\sqrt{a^{\,3}}\sqrt{bc}}$

(4 marks)

Total 10 marks

Question 4

a. Evaluate $(1.002)^9$ using the binomial theorem correct to 3 decimal places

(8 marks)

b. An infectious disease begins to spread in a small city of population 10,000. After t days , the number of people who have succumbed to the virus is modeled by the function

$$v(t) = \frac{10{,}000}{5 + 1245e^{-0.7t}}$$

i. How many infected are there initially? (at time t =0).

ii. Find the number of infected people after one day, two days and three days.

(6 marks)

c. Resolve $\frac{2x+3}{(x-2)^2}$ into partial fractions.

(6 marks)

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Total 20 marks

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Question 5

a. A vertical tower stands on level ground. At a point 105m from the foot of the tower the angle of elevation of the top is 19°. Find the height of the tower.
(5 marks)

b. Convert the following angles to radians
(i) 73° (ii) 25°37'
(2 marks)

c. Convert 0.743 radian to degrees and minutes
(1 mark)

d. A flag pole stands on the edge of the top of a building. At a point 200m from the building the angles of elevation of the top and bottom of the pole are 32° and 30° respectively. Calculate the height of the flag pole.
(6 marks)

e. Prove that $\frac{1+\cot\theta}{1+\tan\theta} = \cot\theta$ (6 marks)

Total 20 marks

END OF SECTION B

END OF QUESTIONS

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Please Turn the Page for Formula sheet

Formula Sheet

Formula sheet

Coefficients in the expansion														
							1							
						1		1						
					1		2		1					
				1		3		3		1				
			1		4		6		4		1			
		1		5		10		10		5		1		
	1		6		15		20		15		6		1	

$$(a + b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}b^3 + \ldots\ldots\ldots + b^n$$

END OF PAPER