Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	BNP20203
PROGRAMME CODE	:	BNA/BNB/BNC
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **FOUR (4)** QUESTIONS ONLY PART A - ANSWER (1) QUESTION PART B – ANSWER (3) QUESTIONS

THIS QUESTION PAPER CONSISTS OF **THIRTEEN (13)** PAGES

PART A: THIS PART HAS ONE (1) QUESTION, COMPULSORY TO ANSWER.

Q1 (a) Explain **TWO (2)** different assumption of Euler's Formula and Secant Formula

(5 marks)

(b) The uniform column AB consist of 3.5 m section of tubing having cross section as shown in **Figure Q1 (a)** and **Figure Q1 (b).**

(i) Using Euler's Formula and a factor of safety of two, determine the allowable centric load for the column and the corresponding normal stress.

(8 marks)

(ii) Assuming that the allowable load, found in part (i), is applied as shown in Figure Q1(a). It is observed that the maximum deflection of the column is 5mm. Determine the eccentricity of the load and the maximum stress of the column. Use E = 200 GPa, A = 3400 mm^2, I = 7.93×10^{-6} m^4, r = 48.3 mm.

(12 marks)

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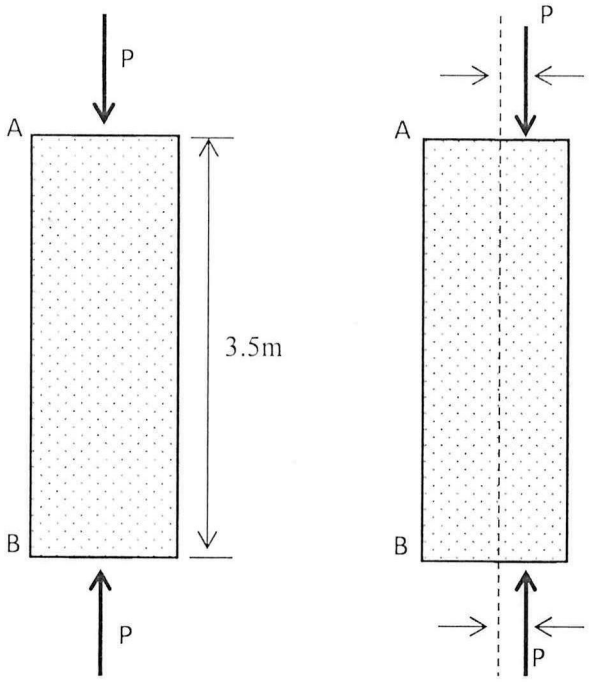

Figure Q1 (a)

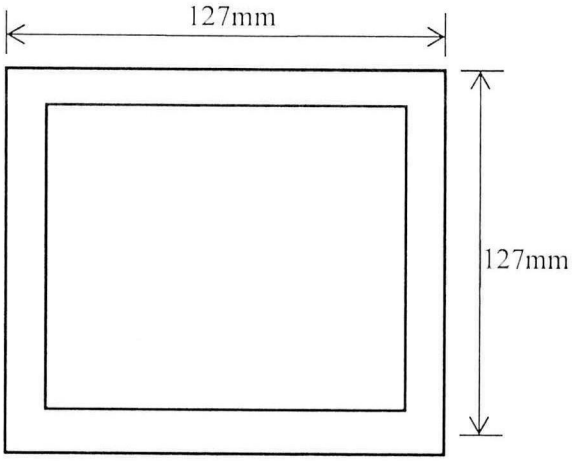

Figure Q1 (b)

PART B: THIS PART HAS FOUR (4) QUESTIONS; PLEASE CHOOSE THREE (3) QUESTIONS TO ANSWER.

Q2 A plane element is subjected to a set of stresses as shown in **Figure Q2.**

(a) Determine the principal stresses and the locations of the planes where they occur.

(5 marks)

(b) Determine the maximum shearing stresses and the locations of the planes where they occur.

(5 marks)

(c) Determine the normal and shearing stresses at a plane making an angle of 45^{0} from the x-plane.

(5 marks)

(d) Prove the answers from (a)-(c) by using Mohr circle.

(10 marks)

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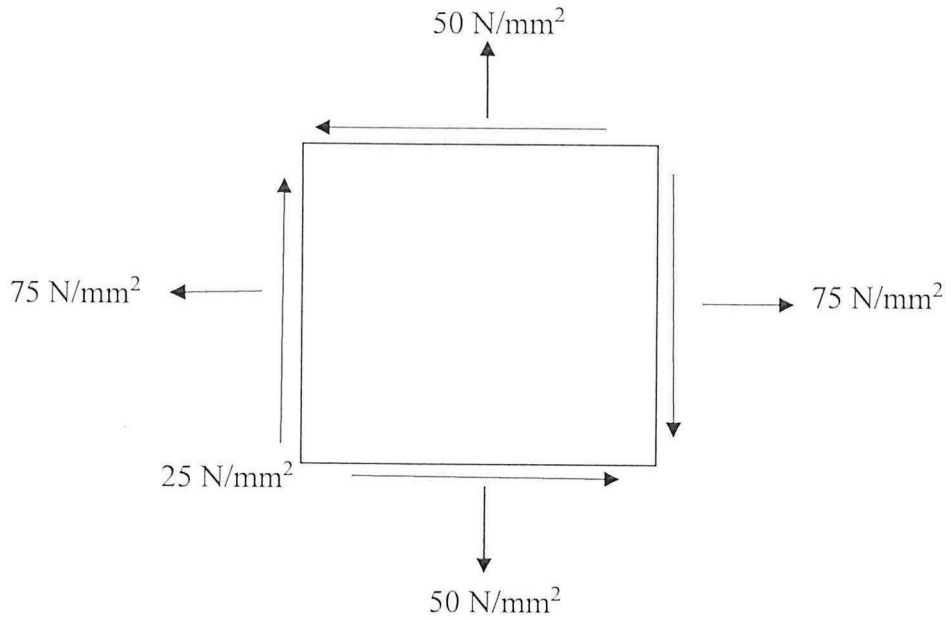

Figure Q2

Q3 The simply supported beam which has length 6 m is as shown as in **Figure Q3**. It is loaded with triangular distributed load of 6 kN/m from A to B and uniformly distributed load 4 kN/m from B to D, respectively. Also, the moment at point A and point load of 7.5 kN is at point E.

(a) Prove the beam is statically determinate beam.

(5 marks)

(b) Calculate the support reactions.

(5 marks)

(c) Sketch and analysis the shear force diagram.

(7.5 marks)

(d) Sketch and analysis the bending moment diagram.

(7.5 marks)

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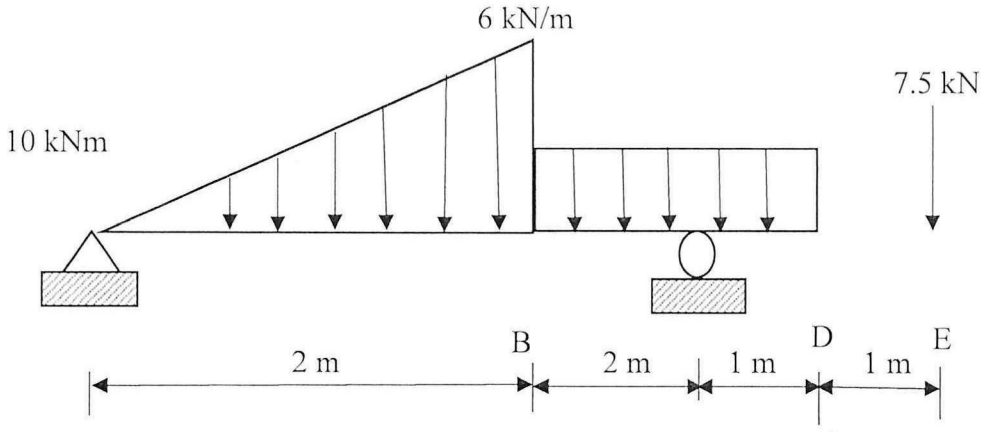

Figure Q3

Q4 **(a)** Describe the following statement;

(i) Types of Internal forces

(2 marks)

(ii) What types of external forces or load should be applied in truss system and which part at the truss that the load should be exerted

(4 marks)

(b) **FIGURE Q4 (a)** shows a truss structure which supported by a pin at joint A and a roller at joint H. Vertical load of 150 kN and horizontal load 120kN are applied at joint F and B respectively. Using Method of Sections, determine the following statement;

(i) Determine the stability and determinacy of the truss structure.

(3 marks)

(ii) Calculate the reaction force at Joint A and joint H.

(3 marks)

(iii) Determine the force in member DF, DG and EG only. State if the members are in tension or compression.

(13 marks)

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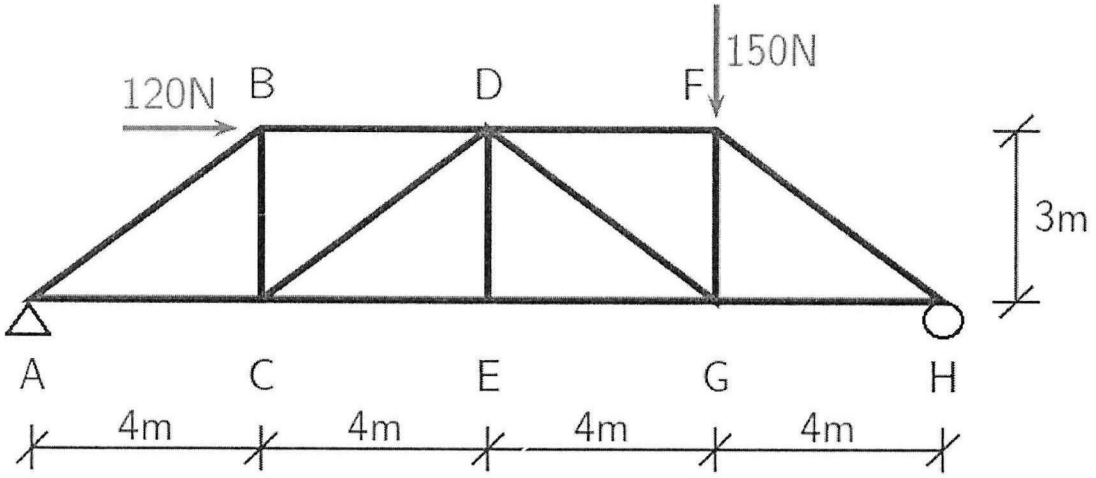

Figure Q4 (a)

Q5 A simply supported beam with overhangs and multiple loads shown in **Figure Q5 (a).** Given EI= 20 x 10^3 kNm^2. Solve the problems by using Macauly's Method.

(i) Define reaction force at point B and E.

(4 marks)

(ii) Determine the boundary condition.

(2marks)

(iii) Derive the general equation of bending moment, slope-deflection and deflection-equation of the beam.

(8 marks)

(iv) Calculate the displacement at the mid span between support B and E.

(7 marks)

(v) Calculate the displacement at the Point A

(4 marks)

- END OF QUESTION

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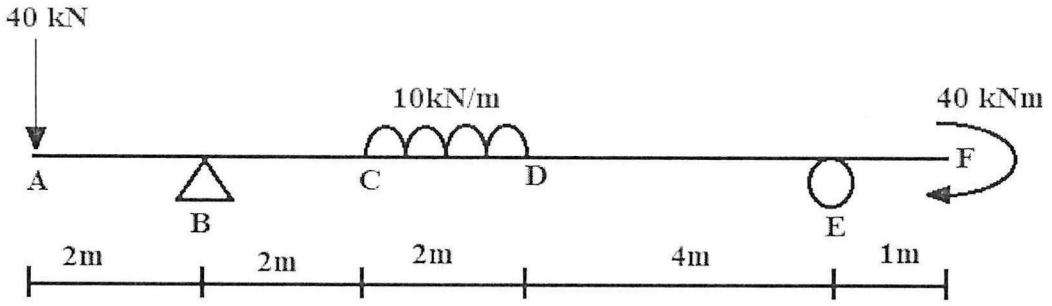

Figure Q5 (a)

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LIST OF EQUATIONS

1. $\sigma = \frac{P}{A}$
2. $\tau = \frac{P}{A}$
3. $\varepsilon = \frac{\delta}{L}$
4. $\sigma = E\varepsilon$
5. $\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$
6. $\sigma_{y'} = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta$
7. $\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$
8. $\sigma_{max,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2_{xy}}$
9. $R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2_{xy}}$
10. $\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2_{xy}}$
11. $tan2\theta_{p=} \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$
12. $tan2\theta_{S=} - \frac{\sigma_x - \sigma_y}{2\tau_{xy}}$
13. $I_x = \frac{bh^3}{12}$; $I_y = \frac{b^3h}{12}$; $I_{circle} = \frac{\pi d^4}{64}$
14. $\sigma = \frac{My}{I}$

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15. $Pcr = \frac{\pi\text{^}2\ EI}{L^2}$

16. $\sigma = \frac{P}{A}$

17. $y\ max = e\left[sec\sqrt{\frac{p}{EI}\frac{L}{2}} - 1\right]$

18. $\sigma_{max} = \frac{P}{A}\left[1 + \frac{e.y}{r^2}sec\left(\frac{L}{2r}\sqrt{\frac{P}{EA}}\right)\right]$