Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2016/2017

| | | |
|---|---|---|
| COURSE NAME | : | MECHANICS OF MATERIALS |
| COURSE CODE | : | BNP20203 |
| PROGRAMME CODE | : | BNB/BNC |
| EXAMINATION DATE | : | JUNE 2017 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWERS **FOUR (4)** QUESTIONS ONLY |

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

**Q1** A plane element is subjected to a set of stresses as shown in **FIGURE Q1.**

(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 $10^{0}$ (counter clockwise) from the x-plane.

(5 marks)

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

(10 marks)

**Q2** The simply supported beam which has length 3.6 m is as shown as in **FIGURE Q2**. It is loaded with uniformly distributed load of 40 kN/m from A to B. Also, the moment 25 kNm and 15 kNm at point A and C, respectively.

(a) Calculate the support reactions.

(5 marks)

(b) Sketch the shear force diagram.

(7.5 marks)

(c ) Sketch the bending moment diagram.

(7.5 marks)

(d) Determine the inflection point.

(5 marks)

**FINAL EXAMINATION**

SEMESTER/SESI: SEM II/2016/2017 PROGRAMME: 2BNB/2BNC
COURSE NAME: MECHANICS OF MATERIALS COURSE CODE: BNP 20203

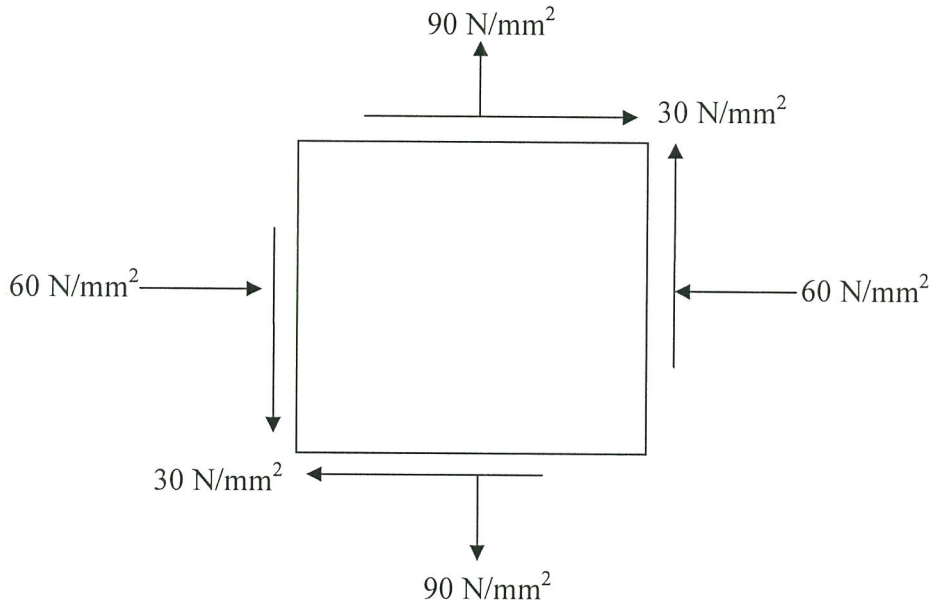


**Figure Q1**

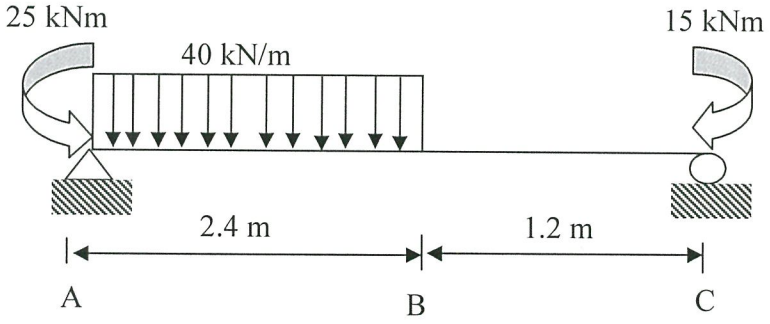


**Figure Q2**

**Q3** (a) There are a number of assumptions that were made in order to develop the Elastic Theory of Bending. List down **five (5)** assumptions for develop the theory.

(5 marks)

(b) The beam simply supported is loaded by the point load, 100 kN at B and C as in **FIGURE Q3 (a)**. The cross section of the beam is shown in **FIGURE Q3 (b).**

(i) Determine the maximum shear and moment along the beam.

(6 marks)

(ii) Calculate the moment inertia, $I$ of the cross sectional area.

(8 marks)

(iii) Determine the shearing stress at point **a** and **b** sketch the shearing stress distribution diagrams.

(6 marks)

**FINAL EXAMINATION**

SEMESTER/SESI: SEM II/2016/2017 PROGRAMME: 2BNB/2BNC

COURSE NAME: MECHANICS OF MATERIALS COURSE CODE: BNP 20203

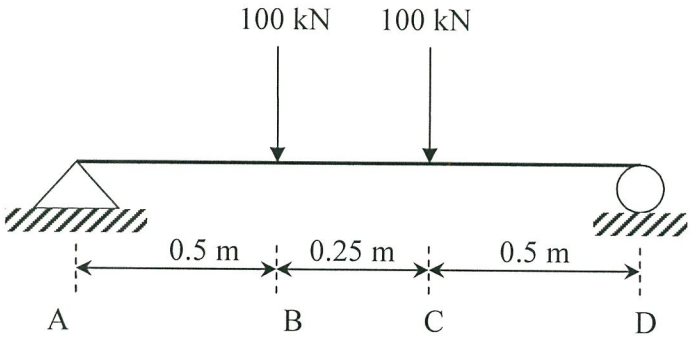


**Figure Q3 (a)**

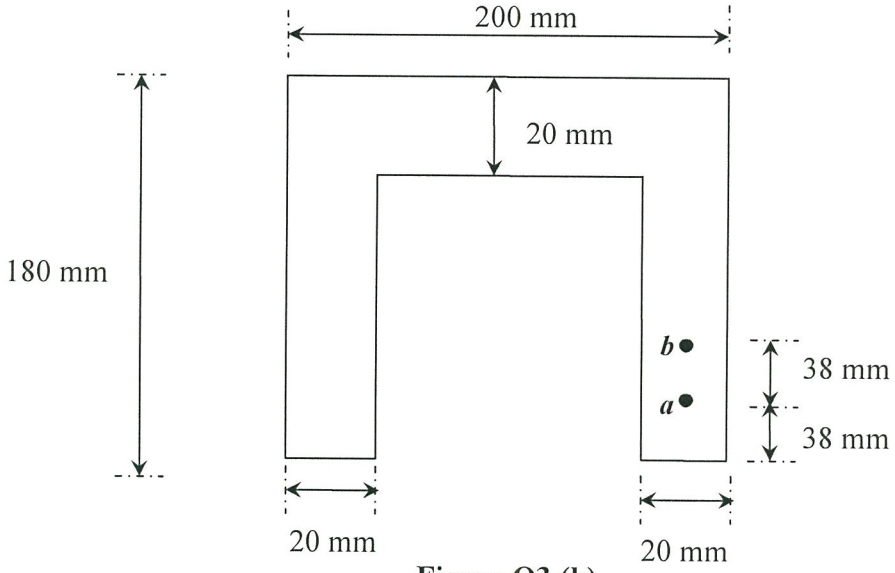


**Figure Q3 (b)**

**Q4** (a) Based on **FIGURE Q4 (a),** provide 4 boundary conditions that can be used to obtain the value of constant '*C*' in double integration method.

(10 marks)

(b) A horizontal beam which is simply supported at its end, A and B, have a uniform cross-section. It's length is 14 m and point load of 12 kN and 8 kN are acted at 3 m from A and 4.5 m from B, respectively. By using Macaulay Method, calculate the deflection of the beam at points under the two loads. EI = constant.

(15 marks)

**FINAL EXAMINATION**

SEMESTER/SESI: SEM II/2016/2017 PROGRAMME: 2BNB/2BNC
COURSE NAME: MECHANICS OF MATERIALS COURSE CODE: BNP 20203

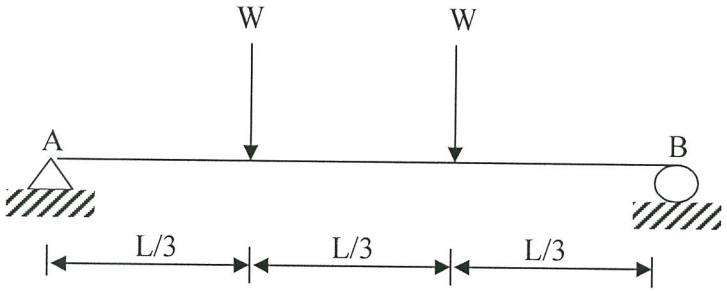


**Figure Q4 (a)**

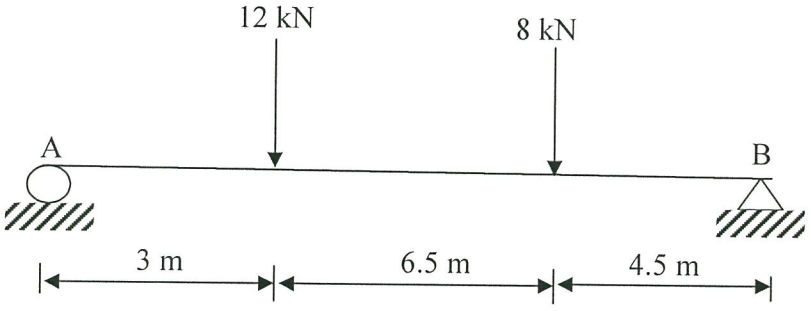


**Figure Q4 (b)**

**Q5** (a) List **two (2)** assumptions of analysis to determine the member's force of the truss.

(2 marks)

(b) The structure mechanics involves determination of unknown forces on the structures. Identify the equations for determination of its equilibrium.

(3 marks)

(c) In **FIGURE Q5**, a statically determinate plane truss is pinned at A and supported by roller at C.

(i) Prove that plane truss is statically determinate structure.

(2 marks)

(ii) Determine the support reaction at A and C.

(5 marks)

(iii) Determine all member forces by using Method of Joints. All interior angles are $60^0$. State if the members are in tension or compression. Assume all members are pin connected.

(13 marks)

**- END OF QUESTION -**

**FINAL EXAMINATION**

SEMESTER/SESI: SEM II/2016/2017
PROGRAMME: 2BNB/2BNC
COURSE NAME: MECHANICS OF MATERIALS
COURSE CODE: BNP 20203

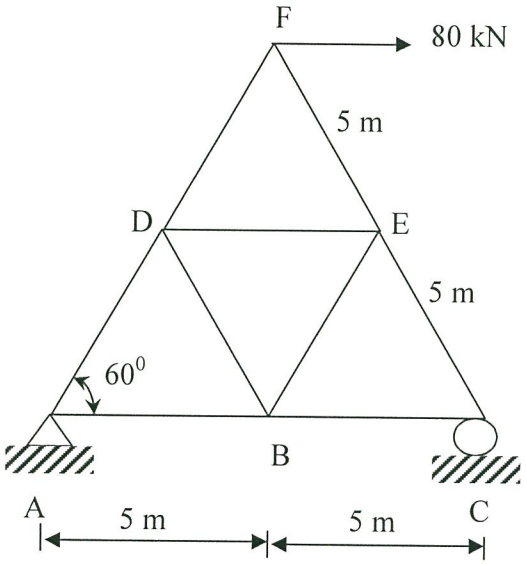


**Figure Q5**

**CONFIDENTIAL**

**FINAL EXAMINATION**

SEMESTER/SESI: SEM II/2016/2017
PROGRAMME: 2BNB/2BNC
COURSE NAME: MECHANICS OF MATERIALS
COURSE CODE: BNP 20203

## 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. $\sigma_{max,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right) + \tau^2_{xy}}$
9. $\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right) + \tau^2_{xy}}$
10. $tan2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$
11. $I_x = \frac{bh^3}{12}$ ; $I_y = \frac{b^3h}{12}$ ; $I_{circle} = \frac{\pi d^4}{64}$
12. $\sigma = \frac{My}{I}$