UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	MECHANIC OF MATERIALS
COURSE CODE	:	BFC 20903
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Based on **FIGURE Q1(a)**, define **NINE** (9) stress components that corresponds to the x, y, z axis.

(6 marks)

(b) Consider a rod AB is placed between two fixed supports and carries a tensile force of P as shown in **FIGURE Q1(b)**. If the rod undergoes temperature change ΔT, prove that the temperature stress equation is $\sigma = \frac{P}{A} = -E\alpha(\Delta T)$.

(5 marks)

(c) Given the principal plane and principal stresses for a bracket which has a uniform thickness of 15 mm are σ_{max} = 20 MPa, σ_{min} = 5 MPa and θ = 35^0 clockwise. Using Mohr circle method,

(i) Calculate the stresses before the plane rotated.

(7 marks)

(ii) Calculate the stresses after the plane rotated at θ = 22.5^0 counter clockwise.

(4 marks)

(iii) Determine the maximum shearing stress.

(3 marks)

Q2 A cantilever beam shown in **FIGURE Q2(a)** is subjected to a triangular load of *w* kN/m along the beam length within 0 < x < L m.

(a) Determine the shear and moment equations in the beam.

(5 marks)

(b) Draw the shear and moment diagrams if w = 3 kN/m and L = 4000 mm

(4 marks)

(c) The beam has a cross section area in the shape of T-beam with hollow section as shown in **FIGURE Q2(b)**. Calculate the bending stress that occurs at point A, B and C by showing the stress distribution over the beam cross section.

(16 marks)

Q3 A cantilevere beam shown in **FIGURE Q3** is subjected to a couple moment $\mathbf{M_o}$ at its end. Assume *EI* is a constant. Solve the following problems by using Double Integration method.

(a) Draw the elastic curve (deflection diagram) and define its moment function of the beam due to the moment $\mathbf{M_o}$.

(4 marks)

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

(6 marks)

(c) Determine the boundary condition of the beam.

(2 marks)

(d) Consider the beam to have a length of 3.6 m, support a couple moment of 20 kN.m, and be made of steel having E = 200 GPa. Using the moment inertia I = 6.8 x 10^6 mm^4, determine the slope and displacement at C.

(13 marks)

Q4 (a) Explain clearly with the aid of sketches the followings terms

(i) Critical Load

(5 marks)

(ii) Stable Equilibrium

(5 marks)

(iii) Unstable Equilibrium

(5 marks)

(b) **FIGURE Q4** shows a column member AB pinned at both ends about the x-x axis and fixed about both ends in the y-y axis. Determine the maximum allowable intensity W of the distributed load that can be applied to member BC without causing member AB to buckle.

Use a factor of safety with respect to buckling of 3, assume σ_y = 360 MPa and E = 200 GPa.

(10 marks)

Q5 (a) With the aid of sketch, explain **TWO** (2) application of torsion in beam.

(4 marks)

(b) Explain the Right Hand Rule in determining the direction of torsion vector.

(3 marks)

(c) **FIGURE Q5** shows multiple bars rigidly connected to a wall. Rod AB is a solid circular section with 100 mm diameter and rod BC is circular hollow section with 75 mm outer diameter and thickness of 15 mm. Length of rod AB and BC are 1.5 m and 0.75 m respectively. 25 kNm and 50 kNm torsion are applied at point B and C respectively.

(i) Calculate polar moment of inertia for both rods.

(6 marks)

(ii) Determine the maximum shear stress values.

(8 marks)

(iii) If the rod shear stress capacity is 300 N/mm^2, predict whether the rod can withstand the applied torsion. If the rod failed, propose a method so that the rod can withstand the applied torsion.

(4 marks)

Q6 (a) Explain with the aid of sketches the following terms

(i) Purlins.

(3 marks)

(ii) Knee Brace.

(3 marks)

(iii) Gusset Plate.

(3 marks)

(b) A pin-connected truss is loaded with vertical and horizontal point load and supported as shown in **FIGURE Q6**. Calculate all internal member forces by using Method of Joint.

(16 marks)

- END OF QUESTION –

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2014/2015 PROGRAMME : 2 BFF
COURSE NAME : MECHANICS OF MATERIAL COURSE CODE: BFC 20903

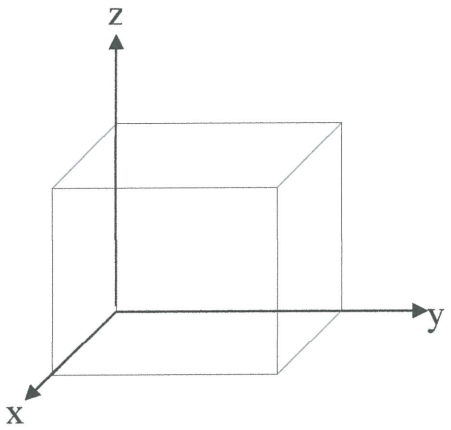

FIGURE Q1(a)

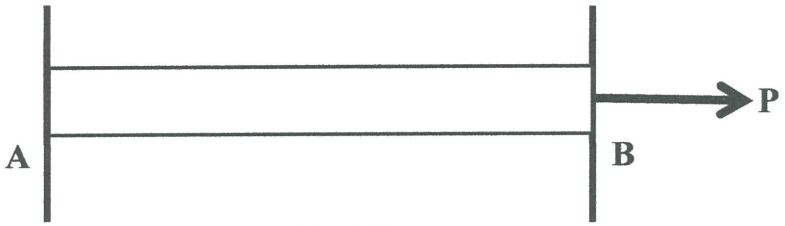

FIGURE Q1(b)

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2014/2015 PROGRAMME : 2 BFF
COURSE NAME : MECHANICS OF MATERIAL COURSE CODE: BFC 20903

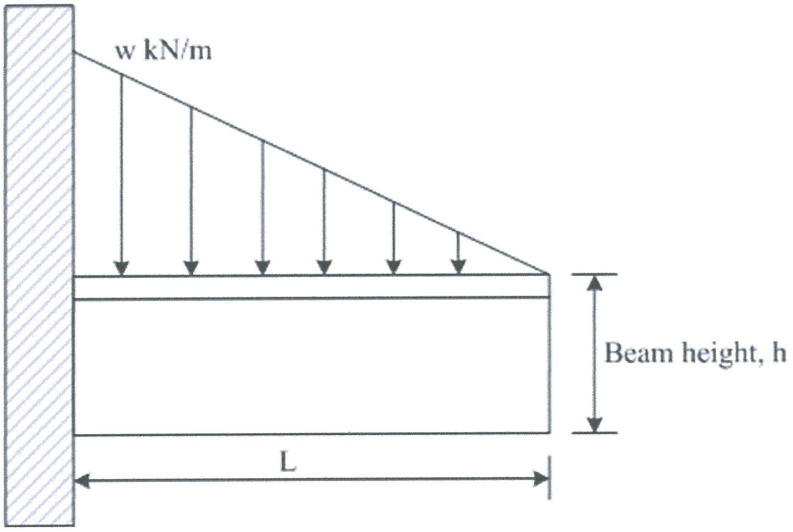

FIGURE Q2(a)

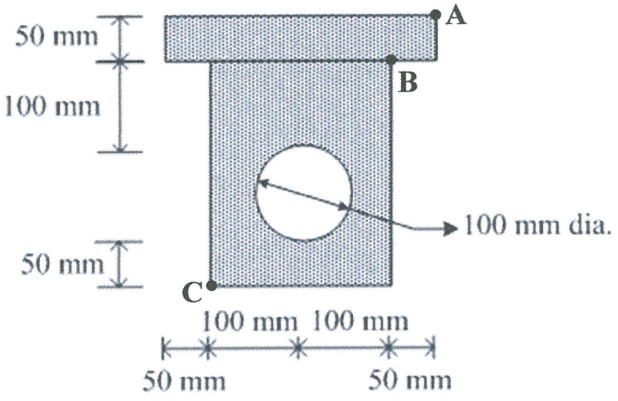

FIGURE Q2(b)

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2014/2015 PROGRAMME : 2 BFF
COURSE NAME : MECHANICS OF MATERIAL COURSE CODE: BFC 20903

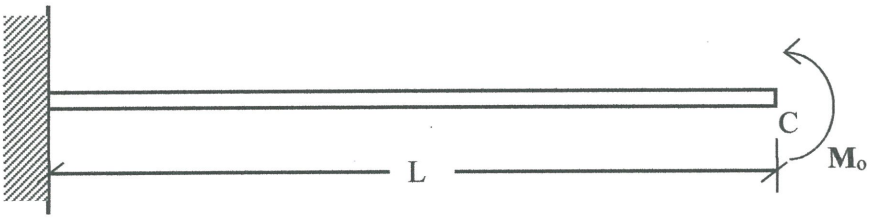

FIGURE Q3

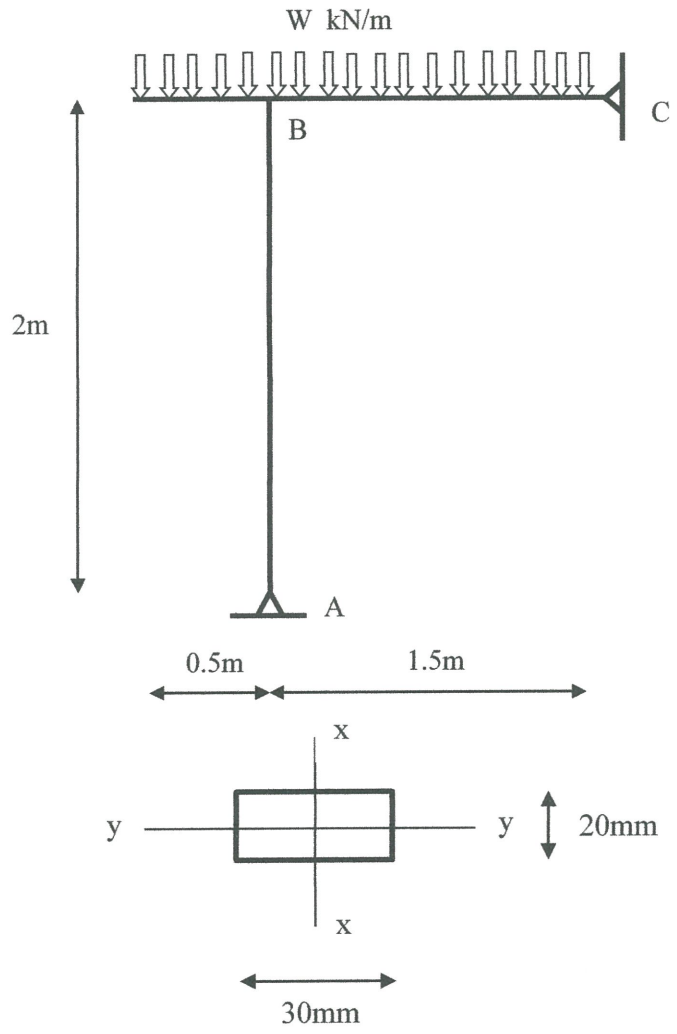

FIGURE Q4

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2014/2015 PROGRAMME : 2 BFF
COURSE NAME : MECHANICS OF MATERIAL COURSE CODE: BFC 20903

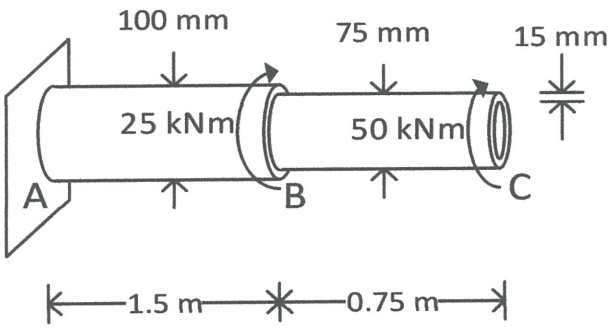

FIGURE Q5

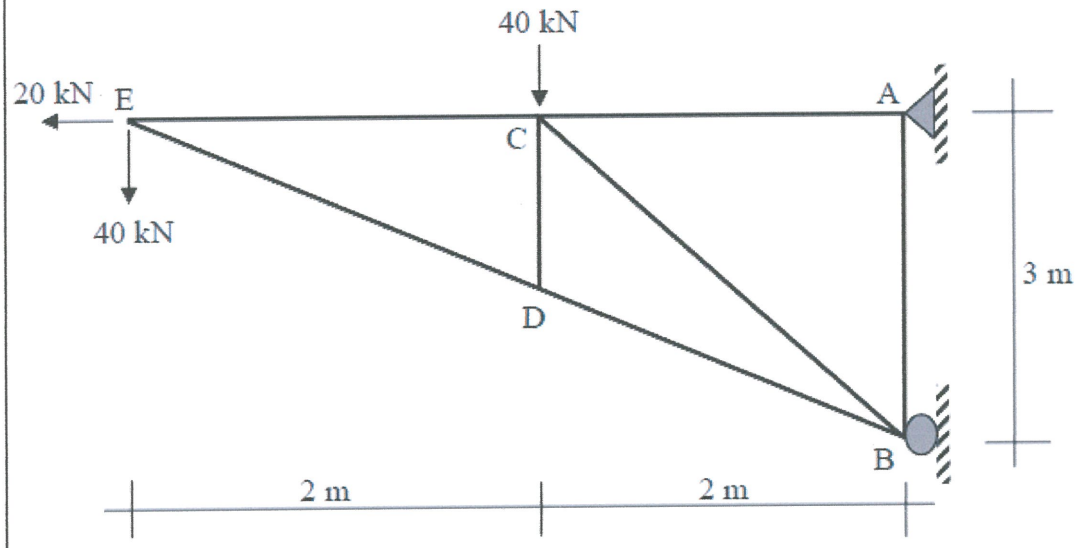

FIGURE Q6