THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering
Bachelor of Technology (Civil) - Level 3

CEX3234 - Strength of Material

Final Examination - 2015/2016

Time Allowed : **3 Hours**

Date: 2016/11/24 Time 9:30 - 12:30 hrs.

The paper consists of ***Eight (08)*** Questions. Answer any ***Five(05)*** Questions.
All questions carry ***equal*** marks.

Q1. (a) Describe the elastic and plastic behavior of an engineering material.
(b) A cylindrical steel pressure vessel 400mm internal diameter with a wall thickness of 20mm, is subjected to an internal pressure of 4.5MPa
i) Calculate the tangential and longitudinal stresses in steel
ii) To what value may the internal pressure be increased, if the stress in steel is limited to 120 MPa?
iii) If the internal pressure were increased until the vessel burst, sketch the direction of fracture that would occur? Justify your answer.

(20 marks)

Q2. (a) Determine the largest weight can be supported by two wires (AB and BC) shown in Fig-Q2(a). The stress in either wire is not to exceeded 40MPa. The diameter of the wires AB and AC are 4mm and 6mm, respectively.

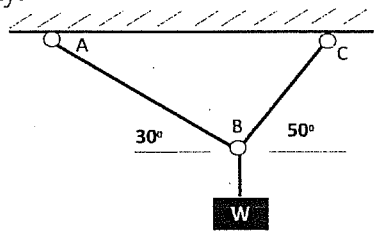

Fig. Q-2(a)

(b) Draw the Bending momnet and Shear force digrams for the beam shown in Fig-Q2(b).

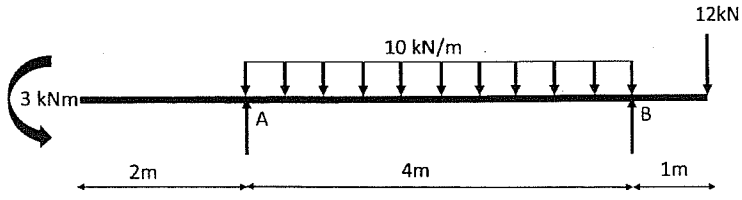

Fig. Q-2(b)

(20 marks)

Q3. (a) State the bending formula (Flexure Formula).

(b) An I section girder Fig.Q-3, 200mm widthand 300mm depth flange and web of thickness 20mm is used as simply supported beam for a span of 7m. The girder carries uniformly distirbuted load of 5kN/m and concentration load of 20kN at mid sapn.

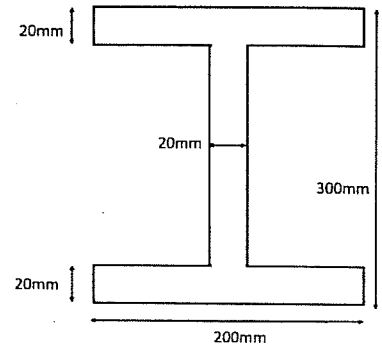

Fig. Q-3

i) Determine the second moment of area of the cross-section of the girder

ii) Calculate the maximum stress set up in the section
Hint: Maximum moment of the beam occurred at the mid span

(20 marks)

Q4. (a) How do you define"Principle Stresses" on Mohr's Stress Circle?

(b) The state of plane stress at a point is represented by the stress element below(Fig. Q-4).

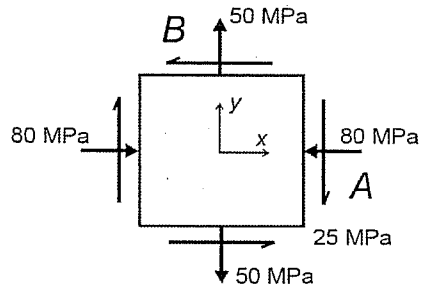

Fig. Q-4

i) Draw the Mohr's Circle for the element. Clearly state the sign convention

ii) Determine the Principle stress and maximum shear stress

iii) Draw the corresponding stress element

(20 marks)

Q5. (a) Show that total energy stored in a shaft per unit volume is equal to $t^2/4G$.
Where; t= Shear stress acting on the shaft G= Modulus of Rigidity
Hint: You may use Torsional formula.

(b) A hollow shaft 50mm and 30mm external and internal diameter respectively, 0.7m long is subjected to a toque of 1200Nm. Calculate the shear stress and the angle of twist.
(G=90GPa)

(20 marks)

Q6. (a) Explain the "Moment Area Method".

(b) Determine the slope and deflection of the cantilever beam at "B" using Moment Area Method (Fig. Q-6). (EI is constant)

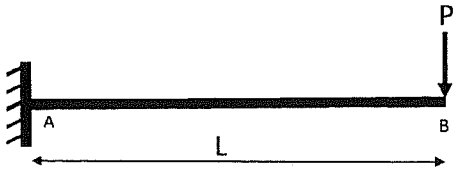

Fig. Q-6

(20 marks)

Q7. (a) Define following engineering terms
i) Working stress
ii) Ultimate stress
iii) Factor of safety

(b) A composite bar is constructed from a steel rod of 25mm diameter surrounded by a copper tube of 50mm external diameter and 25mm internal diameter. The rod and tube are joined by two 20mm diameter pins as shown in Fig. Q-7. Find the shear stress set up in the pins if after pining, the temperature raised by 50°C.

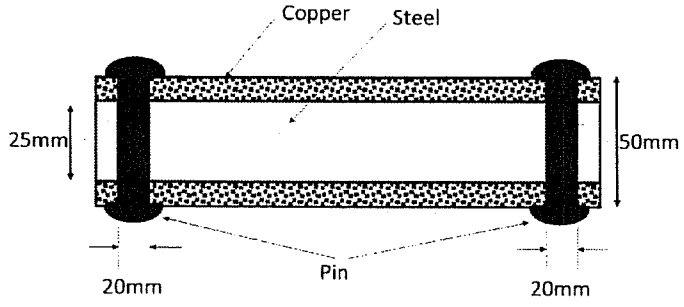

Fig. Q-7

(20 marks)

Q8. (a) i) Discuss the basic failure of a column subjected to axial load according to the Euler's formula.
ii) Define the "Intermediate steel Column" with reference to slenderness ratio.

(b) A 2.0m long mild steel column of circular section is designed to carry an axial load of 1 MN. If the column is fixed at both ends, determine the minimum diameter required?

Hint: Rankine-Gordon Formula $S_{cr} = s_c/[1+a(L/r)^2]$
Value for "a" equal to 1/30,000 for fixed ends and s_c=320MPa

(20 marks)