The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX5232 Strength of Materials II**
Academic Year	:	2014/15
Date	:	03 – 08 - 2015
Time	:	9.30am – 12.30pm
Duration	:	3 hours

General Instructions

1. Read all instructions carefully before answering questions.
2. This question paper consists of **8 questions**. All questions carry equal marks.
3. Answer any **5 questions** only.

Q1 The dimensions of a T – section of a beam are shown in Figure Q1. The point C is the center of area of the section.

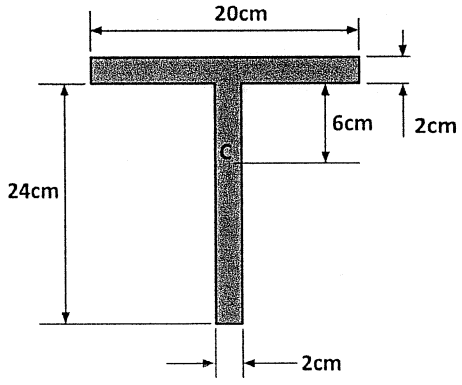


Figure Q1

(a) Calculate the second moment area of the section about the vertical axis and the horizontal axis going through point C. ***6 marks***

(b) A simply supported beam having the T section shown above carries a uniformly distributed load. The span of the beam is 4m.

(i) Sketch the bending moment diagram. ***4 marks***

(ii) Determine the value of uniformly distributed load if the maximum bending stress is to be limited to 200MPa. ***5 marks***

(iii) Sketch the bending stress distribution over the section at the mid span. ***5 marks***

Q2 A built-in beam of length 4m carries a concentrated load of 8kN at the mid span. Flexural rigidity (EI) of the beam is 5200kNm^2.

(a) Sketch the complete bending moment diagram for the above beam. *5 marks*

(b) Find the values of fixing moments. *5 marks*

(c) Find the deflection at the mid span using Moment Area Method *5 marks*

(d) If one of the built-in ends was removed making the beam a cantilever, calculate the deflection at the mid span. *5 marks*

Q3 A closed ended thick cylinder has inner radius of 80mm and outer radius of 120mm.The cylinder is subjected to an internal pressure that produces a maximum hoop stress of 30MN/m^2.

(a) Sketch the variation of hoop and radial stresses with $^1/r^2$, where r is the radius of the cylinder. *10 marks*

(b) Find the internal pressure of the cylinder *5 marks*

(c) Determine the value of external pressure that would reduce the hoop stress at the inner surface by 50%. *5 marks*

Q4 (a) Derive an expression for the total shrinkage at the interface of a compound cylinder made of same material in terms of hoop stresses at the interface, interface radius and the modulus of Elasticity of the material. *5 marks*

(b) A compound cylinder is made having a total interference of 0.02mm. The Interface radius of the compound cylinder is 120mm.The inner radius and the outer radius of the compound cylinder are respectively 80mm and 150mm.

(i) Find the interface pressure. *8 marks*

(ii) This compound cylinder is subjected to an internal pressure equal to that of interface pressure. Find the new interface pressure. *7 marks*

Take Modulus of Elasticity as 200GPa.

Q5 A compound cylinder has been made of two different materials with no interface pressure at the ambient temperature of 30°C. The radii of the compound cylinder and the material properties are as follows.

Inner radius – 50mm, interface radius – 100mm, outer radius – 150mm

For inner cylinder: $E_i = 100GN/m^2$, $\alpha_i = 18 \times 10^{-6}/°C$, $\nu_i = 0.33$
For outer cylinder: $E_o = 200GN/m^2$, $\alpha_o = 12 \times 10^{-6}/°C$, $\nu_o = 0.30$

(i) Find the temperature at which an interface pressure of 10MN/m^2 is induced. *10 marks*

(ii) If the compound cylinder has an initial interface pressure of 5MN/m^2, determine the maximum hoop stress in the compound cylinder at this elevated temperature. *10 marks*

You may use the following equation with usual notation.

$$\frac{1}{E_o}[\sigma_{Ho} + \nu_o p] + \frac{1}{E_i}[\sigma_{Hi} + \nu_i p] = \Delta T(\alpha_o - \alpha_i)$$

Q6 (a) Write down the equation for the shear stress induced in thin wall tubes when subjected to a toque, defining each parameter of the equation. ***6 marks***

(b) A thin walled circular tube of 100mm diameter and 2m in length is firmly restrained at both ends against rotation. A torque of 10kNm is applied at the midpoint of the span. Find the following.

(i) Minimum thickness of the tube considering the maximum permissible shear stress as 200MN/m^2. ***6 marks***

(ii) Minimum thickness based on maximum angle of twist of 3°. ***8 marks***

Modulus of rigidity of the tube material is 300GN/m^2.

You may use the following equation with usual notation.

$$\theta = \frac{LTz}{4A^2tG}$$

Q7 (a) A simply supported beam carries a uniformly distributed load of 10kN/m over the entire span of 3m. The beam section is rectangular having a depth of 20cm and a width of 10cm. The yield stress of the material is 200MPa. Find the following.

(i) Maximum bending moment and maximum bending stress present in the beam ***6 marks***

(ii) Uniformly distributed load that will initiate the yielding ***7 marks***

(iii) Uniformly distributed load that creates plastic hinge at the center. ***7 marks***

Q8 Describe the following with illustrations. You are required to explain how in each case the stresses induced would be determined, where necessary.

(a) Unsymmetrical bending of beams ***5 marks***

(b) Maximum shear stress criteria for elastic failure ***5 marks***

(c) Shear stresses induced in shafts with cellular sections ***5 marks***

(d) Stresses induced in rotating discs with a center hole ***5 marks***

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