The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**DMX4205/ DMX 4575/MEX4275 Strength of Materials I**
Academic Year	:	2019/20
Date	:	30th July 2020
Time	:	0930hrs – 1230hrs
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Six (6)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is an Open Book Test **(OBT)** / Closed Book Test **(CBT).**
7. Answers should be in clear hand writing.
8. Do not use red colour pen.

Question No.01:

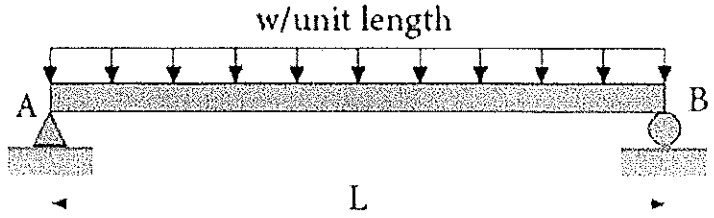


Fig.Q1

A simply supported beam AB shown in Fig.Q1 is subjected to a uniformly distributed load of ***w*** per unit length. Modulus of flexural rigidity (EI) is constant throughout the beam,

a) Draw the free body diagram for the above loading system

b) Find the equation of elastic curve, and hence determine
   i) the maximum slope of the beam and
   ii) the maximum deflection of the beam

Question No.02:

a) State the simple torsion formula with usual notations. Explain the meaning of each symbol in the formula with their relevant units.

b)

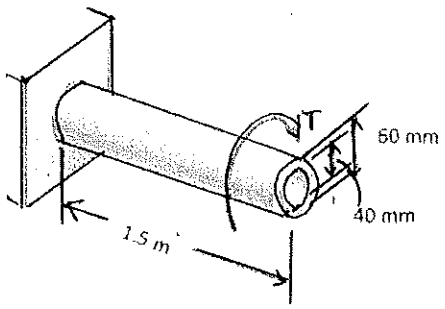


Fig.Q2

Fig.Q2 shows a hollow cylindrical steel shaft 1.5m long and has inner and outer diameters 40 mm and 60 mm respectively.

i) What is the largest torque that can be applied to the shaft if the shearing stress is not to exceed 120 MPa?

ii) What is the corresponding minimum value of the shearing stress in the shaft?

Question No.03:

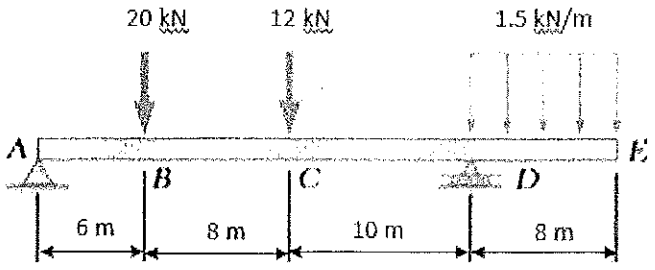


Fig.Q3

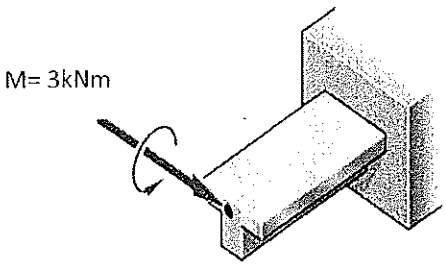
A beam AE, simply supported at A and D, is subjected to 20 kN and 12 kN loads at B and C respectively and a 1.5 kN/m uniformly distributed load over DE as shown in Fig.Q3.

a) Draw the shear force and bending moment diagram for the beam AE
b) Hence find the magnitudes of maximum shear force and maximum bending moment, and their locatons on the beam.

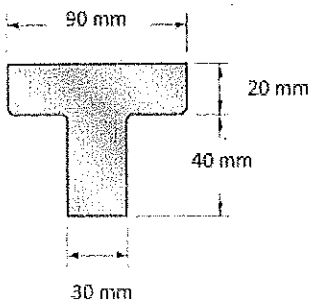
Question No.04:

a) State the simple bending formula with usual notations. Explain the meaning of each symbol in the formula with their relevant units.

b)



(a)



(b)

Fig.Q4

Fig.Q4(a) shows a cast-iron machine part, which is acted upon by a 3 kN-m couple and Fig.Q4(b) shows the cross-sectional dimensions of the beam. Knowing E = 165 GPa and neglecting the effects of fillets, determine

i) the maximum tensile and compressive stresses and
ii) the radius of curvature of the beam.

Question No.05:

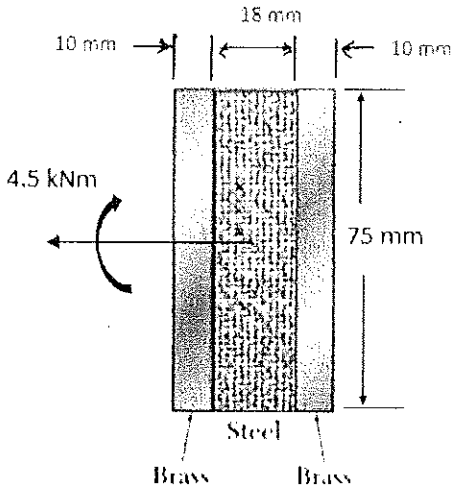


Fig.Q5

Fig Q5 shows a cross-section of a composite bar, which is made of bonded pieces of steel having the modulus of elasticity (E_s), 200 GPa and two pieces of brass having modulus of elasticity of (E_b) 100 GPa and applied 4.5 kNm moment on it.

a) Transform the bar to an equivalent cross section made entirely of brass.
b) Evaluate the cross-sectional properties of the transformed section.
c) Calculate the maximum stress in the transformed section.
d) Determine the maximum stress in the steel and brass when a moment of 4.5 KNm is applied.

Question No.06:

a) Show that the Euler formula for buckling of struts with both ends are hinged can be written as

Euler crippling load, $P_e = \frac{\pi^2 EI}{4l^2}$

Where *Pe* - Critical load , *l* – Length of the strut, *E* – Modulus of elasticity, *I* – Second moment area of the section of the column

b)

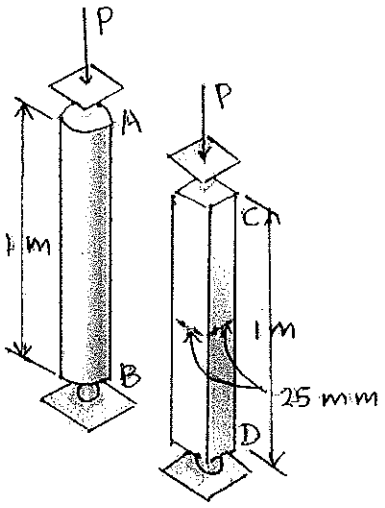


Fig.Q6

Fig.Q6 shows two struts made of same material and same length 1 m, having cross-sections of one is circular and the other square with an area of (25mm x 25mm). Both struts are subjected to a compressive load, **P** as shown in Fig. Q6 and the modulus of elasticity of the material E is 200GPa.

Determine,

i) the radius of the cross section of the circular strut so that the both circular and square struts have the same cross-sectional area and

ii) the critical load for each strut.

Question No.07:

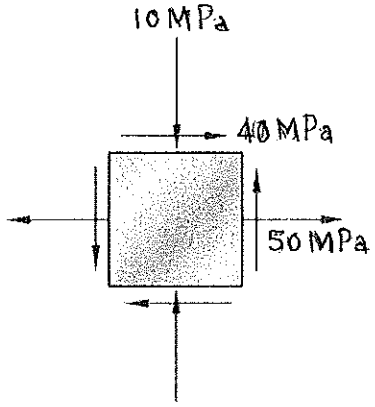


Fig.Q7

a) For the state of plane stress shown in Fig. Q7, construct Mohr's circle.

b) Hence determine,

i) the principal planes,
ii) the principal stresses,
iii) the maximum shear stress and the corresponding normal stress.

Question No.08:

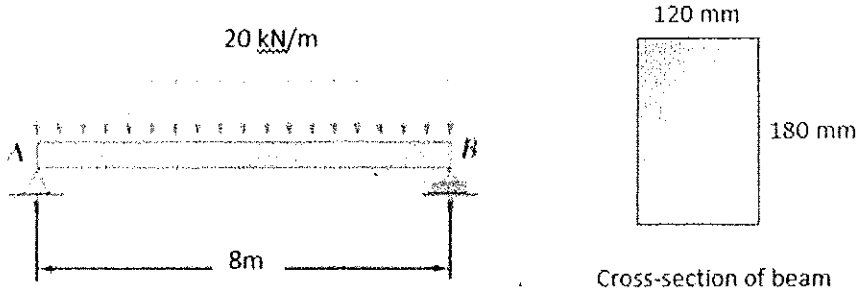


Fig.Q8

A stainless-steel beam (AB) of span 8 m, simply supported at A and B carries a UDL of 20 kN/m over its entire span. The cross-section of the beam is a rectangle with dimensions 120 mm x 180 mm as shown in the Fig. Q8.

a) Find the reactions at supports A and B
b) Determine the shear stresses at planes 30 mm, 60 mm and 90 mm from the top plane.
c) Draw the shear stress distribution at the section 1 m from the left support, by considering horizontal planes 30 mm apart from top to bottom in the cross section.

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