The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX4275 Strength of Materials I**
Academic Year	:	2015/16
Date	:	14th December 2016
Time	:	0930hrs – 1230hrs
Duration	:	3 hours

General instructions

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

Question No.01:

a) Briefly explain with relevant sketches the different types of beams and different types of loads acting on a beam. ***(05 marks)***

b)

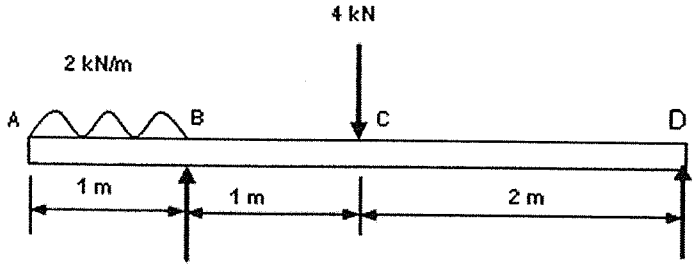


Fig. Q1

A beam ABCD 4m long, simply supported at A and D, is over hanging by 1m to the left of support at B and carries loads as shown in Fig.Q1

I. Determine the reaction forces at B and D.
II. Draw the shear force and bending moment diagrams for the beam.
III. Determine maximum bending moment of the beam and its position.

(15 marks)

Question No.02:

The stresses acting on three mutually perpendicular planes at a point in an elastic material are 72 N/mm^2 tensile and 28 N/mm^2 shear on plane 1, 14 N/mm^2 compressive and 28 N/mm^2 complementary shear on plane 2, and no stress on plane 3.
Use Mohr's circle diagram to show the stress components on different planes and thus calculate

i) The principal stress ***(09 marks)***

ii) The maximum shear stress ***(03 marks)***

iii) The position of the planes on which there is no normal stress ***(04 marks)***

iv) The principal strains ***(04 marks)***

Take Modulus of elasticity (E) = 200x106 N/mm^2 and Poisson's ratio (υ) = 0.3.

Question No.03:

a) State Castigliano's first and second theorems for strain energy. ***(04 marks)***

b) Explain the application of these theorems. ***(04marks)***

c) A simply supported beam of span 3 m, is carrying a uniformly distributed load of 20kN/m over the whole span. Using Castigliano's theorem, obtain the deflection at the center of the beam if section modulus 'EI' of the material is 2.5 MNm^2.

(12 marks)

Question No.04:

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

(05 marks)

b) A solid shaft of 100 mm diameter, which transmits power at a specific speed, is replaced by a hollow shaft capable of transmitting twice as that of the power at 1.5 times as that of the angular speed of the solid shaft. If the hollow shaft has an outside diameter equal to twice its internal diameter and its material has a maximum allowable shear stress equal to 92 % of that of the solid shaft, what would be the dimensions of the new shaft?

(15 marks)

Question No.05:

(a) Draw the typical stress–strain curve for a mild steel and indicate the Elastic region, Plastic region, Yield strength and the Ultimate strength

(05 marks)

(b)

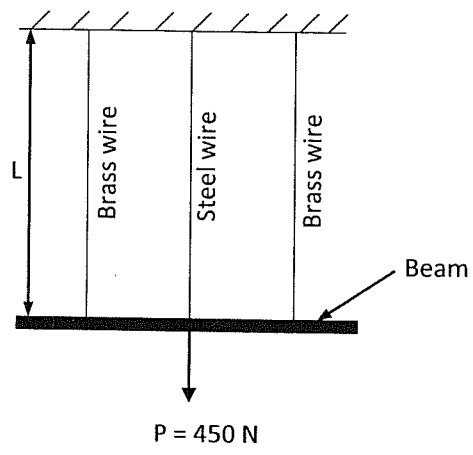


Fig.Q5

A beam weighing 450N is held in a horizontal position by three vertical wires. Two of them are similar with one attached to each end of the beam, and the third to the middle of its length as shown in Fig.Q3. Each outer wire is of brass and has diameter 1.25 mm. The centeral wire is of steel and has diameter 0.625 mm. The beam is rigid, and wires were of the same length and unstressed before the beam is attached. If the Young's Modulus of the brass is 86 GN/m^2 and for steel 210 GN/m^2 , detremine the stresses induced in the wires.

(15 marks)

Question No.06:

(a) Prove that the second moment of area of a triangle having a base '*b*' and height '*h*', about an axis along the base is $bh^3/12$. Hence show that a square section has the same second moment of area about a centroidal axis parallel to a side of the square.

(06 marks)

(b) Fig.Q6 shows an unsymmetrical I-section. Determine the second moment of area about the axes X-X passing through its center of gravity (C.G).

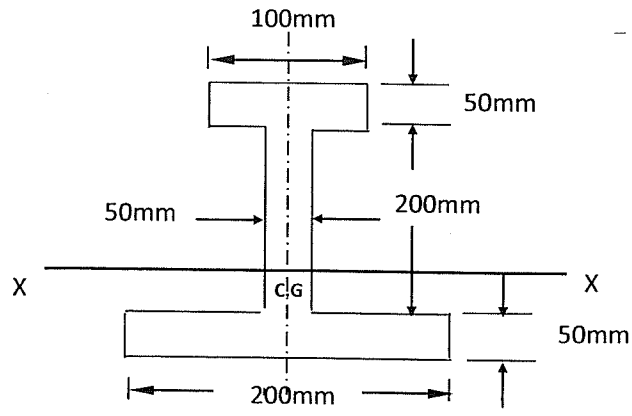


Fig.Q6

(14 marks)

Question No.07:

a) Show that the Euler formula for buckling of struts with built in ends is

$$P_e = \frac{4\pi^2 EI}{L^2}$$

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

b) A bar of length 4 m when used as a simply supported beam and subjected to a uniformly distributed load of 30 kN/m over the whole span, deflects 15 mm at the center. Determine the crippling load when it is used as a column with following end conditions.

i) Both ends pin jointed
ii) One end fixed and other end hinged
iii) Both ends fixed

Note: The deflection (δ) of the mid span of a simply supported beam which carries a uniformly distributed load of intensity '***w***' over its length '***l***' and the flexural rigidity '***EI***' of the beam can be written as $\frac{5wl^4}{384EI}$

Question No.08:

Briefly explain the following.

a) Hardness
b) Elastic limit of a material
c) Ductility
d) Stiffness

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