USN

Third Semester B.E. Degree Examination, De Se of ec5

Strength of Materials

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. State Hooke's law. Derive the expression for change in length of bar using Hooke's law. **(04 Marks)**

b. A steel bar of 25 mm diameter is acted upon by forces as shown in Fig. Q1 (b). Determine the total extension of the bar. E = 2 x 10^5 N/mm^2. **(06 Marks)**

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Fig. Q1 (b)

c. The Bronze bar 3 m long with 320 mm^2 cross sectional area is placed between two rigid walls at —20' C. There is a gap **A** = 2.5 mm as shown in Fig. Q1 (c). Find the magnitude and the type of stress induced in the bar when it is heated to a temperature of 50.6°C. For bronze bar take α_b =18 x10' C and E_b = 80 GPa. **(06 Marks)**

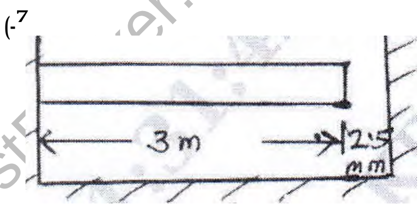

Fig. Q1 (c)

OR

2 a. Derive the relation between modulus of elasticity and modulus of rigidity. **(06 Marks)**

b. Find the total elongation of the bar shown in Fig. Q2 (b) subjected to an axial tensile force of 50 KN on the bar of material having modulus of elasticity= 2.1 x 10^5 N/mm^2. **(04 Marks)**

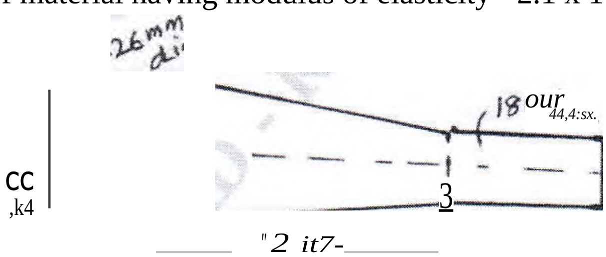

Fig. Q2 (b)

c. A copper rod, 25 mm in diameter is enclosed in steel tube 30 mm internal diameter and 35 mm external diameter. The ends are rigidly attached. The composite bar is 500 mm long and is subjected to an axial pull of 30 KN. Find the stresses induced in the rod and the tube. Take E for steel = 2 x 10^5 N/mm^2 and E for copper as 1 x 10^5 N/mm^2. **(06 Marks)**

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Module-2

3 a. State principal stresses and principal planes. **(04**

b. An element is subjected to stresses as shown in Fig. Q3 (b). Find out stresses on inc: plane AB by Mohr's graphical method. **(06 Ma,**

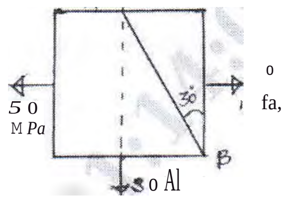

Fig. Q3 (b)

c. A point in a strained material is subjected to the stresses as shown in Fig. Q3 (c).. Locate the principal stresses. Also determine the maximum shear stress. Use analytical approach. **(06 Marks.)**

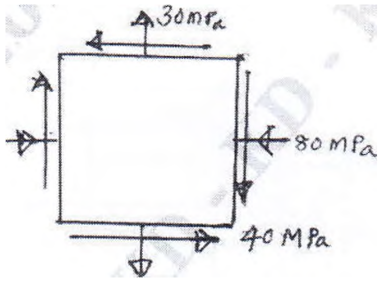

Fig. Q3 (c)

OR

4 a. Differentiate thick and thin cylinders. **(04 Marks)**

b. A cylindrical shell has an external diameter of 500 mm and wall thickness 10 mm. The length of the cylinder is 1.7 m. Determine the increase in its internal diameter and length when inside pressure is 1 N/mm^2. Given E = 210 GPa and Poisson's ratio = 0.3 **(06 Marks)**

c. Draw the radial and hoop stress distribution diagram over the wall of a thick cylinder. The outside diameter of pipe is 150 mm while inside diameter is 70 mm. The pipe is subjected to internal and external pressures 6 MPa and 4 MPa respectively. **(06 Marks)**

Module-3

5 a. Draw SFD and BMD for a simply supported beam carrying udl of intensity ω/m over the entire length. **(04 Marks)**

b. Draw SFD and BMD for a overhanging beam loaded as shown in Fig. Q5 (b). Indicate all salient features. **(12 Marks)**

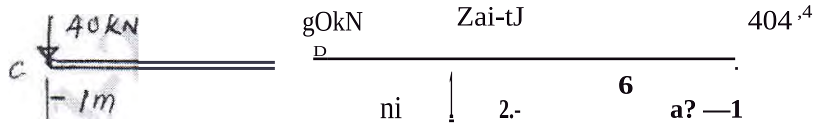

Fig. Q5 (b)

OR

6 a. Derive the relation between load, shear force and bending moment. **(04 Marks)**

b. From the given shear force diagram, shown in Fig. Q6 (b) develop the load diagram and draw BMD. Also determine points of contraflecture if any. **(12 Marks)**

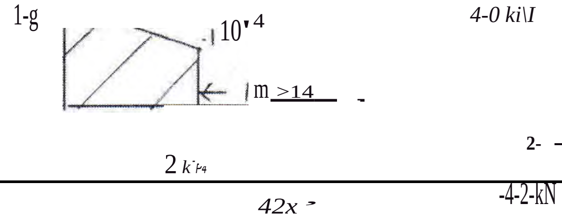

Fig. Q6 (b)

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Module-4

7 a. State the assumptions made in theory of pure bending. Derive bending equation $\frac{M}{I}=\frac{f}{Y}=\frac{E}{R}$ with usual notations. **(06 Marks)**

b. A beam with an I section consists of 180mm xl5rnin flanges and a web of 280 mm deep and 15 mm thickness. It is subjected to a bending moment of 120 KN-m and a shear force of 60 kN. Sketch the bending and shear stress distribution along the depth of the section. Refer Fig. Q7 (b). **Marks)**

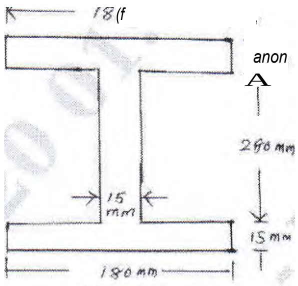

Fig. Q7 (b)

OR

8 a. Derive Euler's expression for buckling load on column with both ends pinned. **(06 Marks)**

b. Design the section of a circular cast iron column to carry a load of 1000 KN. The length of the column is 6 in. Use Rankine's constant $\frac{1}{1600}$ and factor of safety of 3. One end of the column is fixed and other is free. Critical stress is 560 MPa. **(10 Marks)**

Module-5

9 a. With torsional equation explain the following terms.:
  (i) Torsional rigidity:
  (ii) Torsional stiffness. **(04 Marks)**

b. With usual notations derive the equation for torsion. **(06 Marks)**

c. A hollow shaft has outer diameter **100** mm and inner diameter 70 mm. Calculate shear stress acting on elements at the outer and inner surfaces, respectively, due to a torque of 7000 N-m. Draw sketch showing how the shear stress vary in magnitude along a radial line. **(06 Marks)**

OR

10 a. Explain the following theories of failure:
  (i) St. Venant's theory.
  (ii) Tresca's theory. **(08 Marks)**

At a point in a steelinember the major principal stress is 200 MN/m ^{2} and the minor principal stress is compreSSIVe. If the tensile yield point of the steel is 250 MN/m ^{2}, find the value of the minor principal stress at whicli yielding will commence, according to each of the following criteria of failure,
  (i) Maximum shearing stress.
  (ii) Maximum total strain energy.
  (iii) Maximum shear strain energy.

Poisson's ratio = 0.28 **(08 Marks)**