CBCS SCHEME

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17MN34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following :
i) Working stress and factor of safety
ii) Hooke's Law
iii) Draw stress – strain relation for cast iron
iv) Draw stress – strain relation for hard and soft rubber. **(08 Marks)**

b. The following data refer to a mild steel specimen tested in a laboratory.

Diameter of specimen	= 25mm
Extension under a load of 20kN	= 0.04mm
Gauge length	= 200mm
Load at yield point	= 150kN
Maximum load	= 225kN
Length of specimen after failure	= 275mm
Neck diameter	= 18.25mm

Determine :
i) Young's modulus
ii) Ultimate stress
iii) Percentage elongation
iv) Percentage reduction in area. **(12 Marks)**

OR

2 a. Derive an expression for the elongation of uniformly tapering circular bar subjected to axial load P. **(10 Marks)**

b. A brass bar having cross-sectional area 300mm^2 is subjected to axial forces as shown in Fig.Q2(b). Find the total elongation of the bar. E = 84GPa.

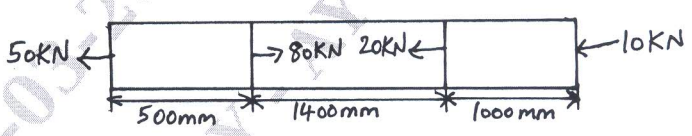

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Define the following :
i) Volumetric strain
ii) Rigidity modulus
iii) Shear stress
iv) Bulk modulus
v) Young's modulus. **(10 Marks)**

b. Determine the changes in length, width and thickness of a steel bar which is 4m long, 30mm wide and 20mm thick and is subjected to an axial pull of 30kN in the direction of length, E = 2 × 10^{5}N/mm^2 and Poisson's ratio = 0.3. Determine the volumetric strain, change in volume and final volume of the given bar. **(10 Marks)**

OR

4 a. Define :
i) Radial stress
ii) Circumferential stress
iii) Longitudinal stress
iv) Thin cylinder. **(04 Marks)**

b. A steel penstock of 100cm diameter and 10mm thick is subjected to 10^5mm head of water. Calculate the hoop stress and longitudinal stress at the bottom of the penstock. **(06 Marks)**

c. Prove that volumetric strain is the sum of longitudinal strain and twice the circumferential strain. **(10 Marks)**

Module-3

5 a. Define beams. Classify and explain various types of beams. **(10 Marks)**

b. A simply supported beam AB of span 6m is loaded as shown in the Fig.Q5(b), draw the shear force diagram and bending moment diagram.

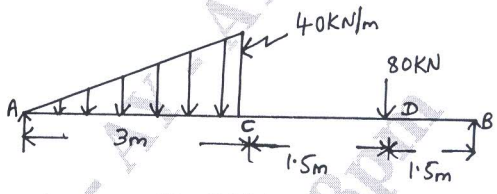

Fig.Q5(b) **(10 Marks)**

OR

6 a. Define Bending moment. **(02 Marks)**

b. Obtain an expression for shear force, bending moment and rate of loading. **(08 Marks)**

v. A cantilever 2m long is loaded with a uniformly distributed load of 10kN/m run over a length of 1.5m from the free end. It also carries a point load of 10kN at a distance of 0.5m from free end. Draw the shear force and bending moment diagram for the beams. **(10 Marks)**

Module-4

7 a. Derive Bernoulli – Euler's bending equation. **(10 Marks)**

b. The Cross-section of a beam is an shown in Fig.Q7(b). If permissible stress is 150N/mm^2. Find its moment of resistance. Compare it with equivalent section of the same area for a square section.

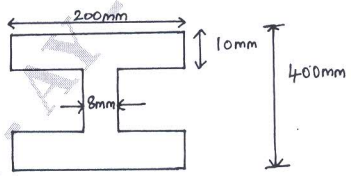

Fig.Q7(b) **(10 Marks)**

OR

8 a. Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress. **(10 Marks)**

b. A beam of length 5m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9kN/m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is 7N/mm^2 and central deflection is not to exceed 1cm. Take E = 1×10^4N/mm^2. **(10 Marks)**

Module-5

9 a. Derive torsional equation with usual notations. **(10 Marks)**

b. A hollow shaft is subjected to a torque 8kN-m. The angle of twist in the shaft is to be limited to 1.7° in a length equal to twenty times the outer diameter. Taking the inner diameter to outer diameter. Taking the inner diameter to outer diameter ratio as 0.7. Determine :

i) Inner diameter and outer diameter

ii) Maximum shear stress induced

Take the modulus of rigidity for the shaft material as 80GPa. **(10 Marks)**

OR

10 a. Derive an expression for Euler's buckling load for column with both ends hinged. **(10 Marks)**

b. A 2.5m long column with hollow circular section is hinged at both ends. External diameter is 140mm and thickness of wall is 20mm. Taking $E = 80 \times 10^9 N/m^2$,

$\alpha = \frac{1}{1600}$ and $\sigma_c = 550MPa$, compare the buckling loads obtained using :

i) Euler's formula

ii) Rankine's formula

Find the length of column for which both formulae give same load. **(10 Marks)**

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