CBCS SCHEME

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17AE34

Third Semester B.E. Degree Examination, July/August 2022
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. Derive the equilibrium equations in polar co-ordinates for a two dimensional state of stress. **(10 Marks)**

b. Consider a displacement field $U = [y^2 i + 3yzj + (4 + 6x^2)k]$. What are the rectangular strain components of the point P(1, 0, 2). **(10 Marks)**

OR

2 a. Draw stress-strain curve for mild steel and mention the salient points. **(04 Marks)**

b. Write a note on material selection for structural performance. **(08 Marks)**

c. A stepped bar of steel, held between two supports as shown in Fig.Q.2(c), is subjected to loads $P_1 = 80kN$ and $P_2 = 60kN$. Find the reactions developed at ends 'P' and 'Q'. **(08 Marks)**

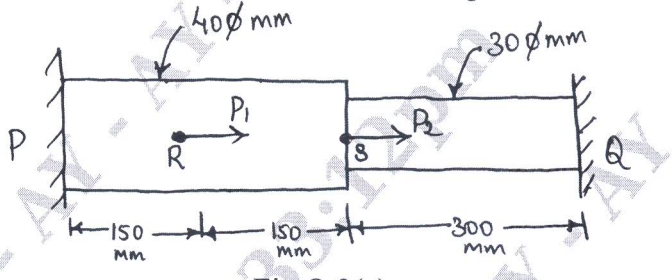

Fig.Q.2(c)

Module-2

3 a. Derive the relations between load, shear force and bending moment. **(08 Marks)**

b. A symmetric I-section beam with flange dimension 180mm × 15mm and web dimension 280 × 15mm is subjected to a bending moment 120kN and a shear force of 60kN. Determine bending stress and shear stress distribution along its depth of the section. **(12 Marks)**

OR

4 a. What is three-dimensional beam theory? Give its kinematic description. **(10 Marks)**

b. Find the principle centroidal bending stiffness of the beam shown in Fig.Q.4(b). the axial stiffness of section is S = Et(bth). **(10 Marks)**

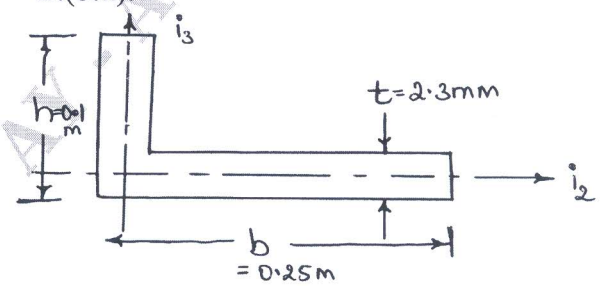

Fig.Q.4(b)

Module-3

5 a. Derive Torsion equation. List its assumption. **(10 Marks)**

b. A hollow cylinder shaft 200mm external diameter and thickness of metal 25mm is transmitting power at 200rpm. The angle of twist over a length of 2m was found to be 0.5°. Calculate the power transmitted and the maximum shear stress induced in the section. Take G = 84GPa. **(10 Marks)**

OR

6 a. Derive following equations for this walled beams:
i) Thin walled assumption
ii) Stress flows
iii) Stress resultants. **(12 Marks)**

b. What is warping of thin walled beam under torsion? Give its kinematic description. **(08 Marks)**

Module-4

7 a. Define principle of virtual work for a particle. Obtain the equilibrium of a particle. **(10 Marks)**

b. List the difference between virtual work and complementary virtual work. **(10 Marks)**

OR

8 a. Explain in detail the following theorems:
i) Castiglione's theorem
ii) Clapeyron's theorem
iii) Maxwell's theorem. **(15 Marks)**

b. Explain conservative force. **(05 Marks)**

Module-5

9 a. Explain Trescas and Von Mises criterions. **(10 Marks)**

b. A rigid rod ABCD is supported by a hinge at 'A' and two wires at 'B' and 'C' as shown in Fig.Q.9(b). Determine the stresses and elongations of two wires. Take E_S = 200GPa and E_C = 100GPa. **(10 Marks)**

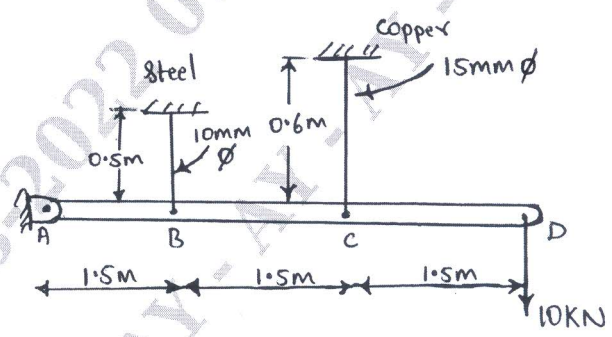

Fig.Q.9(b)

OR

10 a. Derive the six-strain displacement equations of Kirchhoff's plate theory. **(10 Marks)**

b. Derive the displacement equation for a simply supported circular plate under uniform pressure 'P_0'. **(10 Marks)**

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