

CBCS SCHEME

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17AE/AS34

Third Semester B.E. Degree Examination, July/August 2021 Mechanics of Materials

Time: 3 hrs.

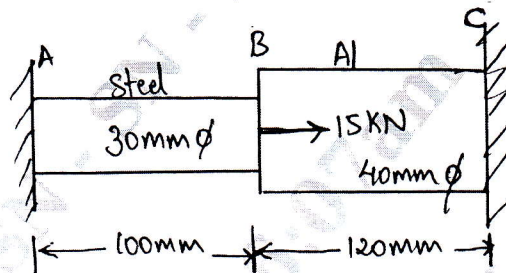
Max. Marks: 100

Note: Answer any FIVE full questions.

1.
 - a. Derive the equilibrium equations in polar co-ordinates for a 2 – D state of stress. (10 Marks)
 - b. Displacement field at a point on a body is given as follows :
 $U = [y^2 \mathbf{i} + 3yz \mathbf{j} + (4 + 6x^2) \mathbf{k}]$. Determine strain components at (1, 0, 2) and express them in Matrix form. (06 Marks)
 - c. Define Plane stress and Plane strain. (04 Marks)

2.
 - a. Write a note on material selection for structural performance. (10 Marks)
 - b. A composite bar, held between two supports as shown in Fig. Q2(b), is subjected to load $P = 15\text{KN}$ at 'B'. Find the reactions developed at 'A' and also find the stress in steel and aluminum. Take $E_a = 70\text{GPa}$, $E_s = 210\text{GPa}$. (10 Marks)

Fig.Q2(b)



3.
 - a. Explain Euler – Bernoulli assumptions with implications. (08 Marks)
 - b. An I – section beam 200mm × 350mm has a web thickness of 12.5mm and a flange thickness of 25mm. It carries a shear force of 200KN at a section. Sketch shear stress distribution across the section. (12 Marks)

4.
 - a. What is Three – Dimensional Beam theory? Give its Kinematic description. (10 Marks)
 - b. What are the governing equations of a Three – Dimensional Beam? Explain. (10 Marks)

5.
 - a. A hollow circular shaft of 6m length and outer diameter of 100mm, having thickness of 12.5mm is subjected to a torque of 10KN-m. If $G = 80\text{GPa}$, determine the maximum shear stress produced and angle of twist. (10 Marks)
 - b. Derive Torsion Equation and list its assumptions. (10 Marks)

6.
 - a. What is warping of thin walled beam under torsion? Give its Kinematic description. (10 Marks)
 - b. Explain the procedure to determine the shear flow distribution over the Open – section of a thin walled beam subjected to transverse shear forces. (10 Marks)

7.
 - a. Define principle of Virtual work for a particle obtain the equilibrium of a particle. (10 Marks)
 - b. What are the differences between principle of virtual work and principle of complementary virtual work? (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 8 a. Explain i) Castiglione's theorem ii) Clapeyron's theorem iii) Maxwell's theorem. (12 Marks)
- b. Derive an expression for slope and deflection at the free end of a cantilever beam of length 'L' carrying point load at its free end. Using Castiglione's theorem. (08 Marks)
- 9 a. What is Buckling of Beam? Explain. (08 Marks)
- b. Two vertical rods one of steel and other of copper are each rigidly fixed at the top and 500mm apart. Diameters and length of each rod are 20mm and 4m respectively. Across bar fixed to the rod at the lower ends carries a load of 5KN, such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take $E_s = 200\text{GPa}$ and $E_c = 100\text{GPa}$. (12 Marks)
- 10 a. Explain Kirchhoff's Plate theory and Mention its assumptions. (08 Marks)
- b. Derive Equilibrium equations of Kirchhoff's plate. (12 Marks)

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