

USN

--	--	--	--	--	--	--	--	--	--

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  $U = [y^2i + 3yzj + (4 + 6x^2)k]$ . 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  $P_1 = 80\text{kN}$  and  $P_2 = 60\text{kN}$ . Find the reactions developed at ends 'P' and 'Q'. (08 Marks)

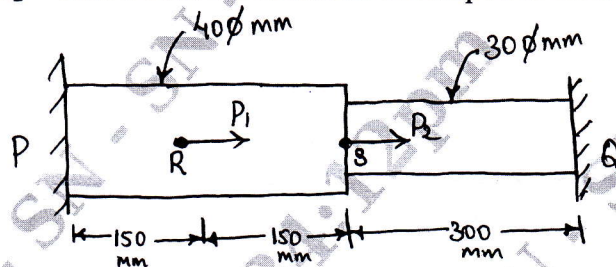


Fig.Q.2(c)

### 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  $180\text{mm} \times 15\text{mm}$  and web dimension  $280 \times 15\text{mm}$  is subjected to a bending moment  $120\text{kN}$  and a shear force of  $60\text{kN}$ . 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)

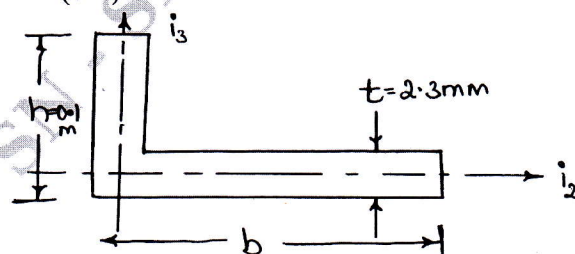


Fig.Q.4(b)

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.

**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  $0.5^\circ$ . Calculate the power transmitted and the maximum shear stress induced in the section. Take  $G = 84\text{GPa}$ . (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  $E_S = 200\text{GPa}$  and  $E_C = 100\text{GPa}$ . (10 Marks)

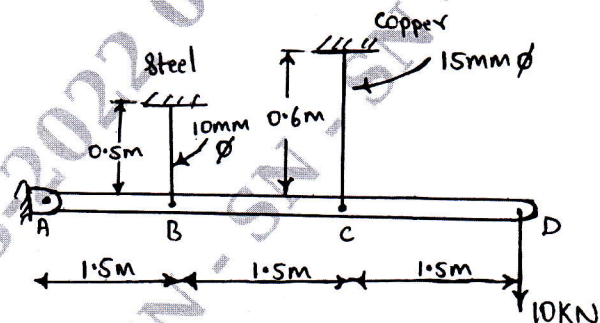


Fig.Q.9(b)

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)

\*\*\*\*\*