## CBCS SCHEME

## Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025 Strength of Materials

Max. Marks: 100

BANGALORE Vote: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M: Marks, L: Bloom's level, C: Course outcomes.

b. Define: i) Strain ii) Poisson's ratio.  c. A 1.5 m long steel bar is having uniform diameter of 40 mm for a length of 1 m. In the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm as shown in Fig.Q.1(c). Determine the elongation of this bar when subjected to an axial tensile load of 160 kN. Given E = 200 GN/m².  Fig.Q.1(c)  OR  Q.2 a. What are the elastic constants and explain them briefly?  6 L2 CO  b. Explain St Venant's principle:  c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, \( \alpha = 12 \times 10^6/\circ\$C.  Module - 2  Q.3 a. For a cantilever beam subjected to a tidl of intensity w/unit length throughout, plot 6 L3 CO						
salient features of the curve.  b. Define: i) Strain ii) Poisson's tatlo:  c. A 1.5 m long steel bar is having uniform diameter of 40 mm for a length of 1 m. In the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm as shown in Fig.Q.1(c). Determine the elongation of this bar when subjected to an axial tensile load of 160 kN. Given E = 200 GN/m².  Fig.Q.1(c)  OR  Q.2 a. What are the elastic constants and explain them briefly?  c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C E = 200 GPa, \( \alpha = 12 \times 12^{\times 10^{\times				-	L	
C. A 1.5 m long steel bar is having uniform diameter of 40 mm for a length of 1 m. In the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm as shown in Fig.Q.1(c). Determine the clongation of this bar when subjected to an axial tensile load of 160 kN. Given £ = 200 GN/m².  Fig.Q.1(c)  OR  Q.2 a. What are the clastic constants and explain them briefly?  b. Explain St Venant's principle:  c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, \(\alpha\) = 12 x 10°°°C.  Module - 2  Q.3 a. For a cantilever beam subjected to a util of intensity w/unit length throughout, plot SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.  SFD and BMD and locate point of contraflexure.	Q.1	a.		6	L2	CO1
the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm as shown in Fig.Q.1(c). Determine the elongation of this bar when subjected to an axial tensile load of 160 kN. Given E = 200 GN/m².  Fig.Q.1(c)  OR  Q.2 a. What are the elastic constants and explain them briefly?  6 L2 CO  b. Explain St Venant's principle:  c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, $\alpha = 12 \times 10^{\circ}$ /°C.  Module - 2  Q.3 a. For a cantilever beam subjected to a ddl of intensity w/unit length throughout, plot SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.  Fig.Q.3(b)		b.	Define: i) Strain ii) Poisson's ratio.	4	L1	CO1
OR  Q.2 a. What are the elastic constants and explain them briefly?  b. Explain St Venant's principle:  c. The steel rod shown in Fig.Q.2(e) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, α = 12 × 10 6/°C.  Module – 2  Q.3 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.		c.	the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm as shown in Fig.Q.1(c). Determine the elongation of this bar when subjected to an axial tensile load of 160 kN. Given $E = 200 \text{ GN/m}^2$ .	10	L3	COI
<ul> <li>Q.2 a. What are the elastic constants and explain them briefly?  b. Explain St Venant's principle:  c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, α = 12 × 10°6°C.  A Module - 2  Q.3 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.  A D E SPD and BMD SPD and SPD SPD SPD SPD SPD SPD SPD SPD SPD SPD</li></ul>			Fig.Q.1(c)			The state of the s
b. Explain St Venant's principle:  4 L2 CO  c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, $\alpha = 12 \times 10^{6/9}$ C.  Module – 2  Q.3 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.  3087  Fig.Q.3(b)			OR			
<ul> <li>c. The steel rod shown in Fig.Q.2(c) is in two parts. It has a diameter of 10 mm for a length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, α = 12 × 10°/°C.</li> <li>Q.3 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot SFD and BMD.</li> <li>b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.</li> </ul>	Q.2	a.	What are the elastic constants and explain them briefly?	6	L2	COI
length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the material, when it is subjected to 70°C. E = 200 GPa, α = 12 × 10°6/°C.  Module - 2  Q.3  a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.	x 1	b.	Explain St Venant's principle:	4	L2	CO
Fig.Q.2(c)  Module – 2  Q.3 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot 6 L3 CO.  SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.		c.	length of 1 m and 20 mm for the remaining length of 1.5 m. If it is constrained between two parts A and B and is stress free at 20°C. Find the stress in the	10	L3	CO
Module – 2  Q.3 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, plot 6 L3 CO SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.			K-1m-44-1.5m-4			A contract of the contract of
A  Por a cantilever beam subjected to a udl of intensity w/unit length throughout, plot  SFD and BMD.  b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.  10 KM  Fig.Q.3(b)  Fig.Q.3(b)		4	Fig.Q.2(c)			
b. For a simply supported overhanging beam as shown in Fig.Q.3(b), draw SFD and BMD and locate point of contraflexure.  A D E 10 KM  Fig.Q.3(b)  Fig.Q.3(b)		Car				
BMD and locate point of contraflexure.  A  D  E  10 KM  Fig.Q.3(b)	Q.3	a.		6	L3	CO
Fig.Q.3(b)		b.	BMD and locate point of contraflexure.	14	L3	CO
1 of 3						
			1 of 3			

			BCV301		
		OR District of the Plat		T 2	CO2
Q.4	a.	For a simply supported beam subjected to udl of w/unit length throughout. Plot SFD and BMD.	6	L3	CO2
	b.	Draw SFD and BMD for the beam shown in Fig.Q.4(b).	14	L3	CO2
		20 KM/m D B			
		Fig.Q.4(b)			
		Module - 3			
Q.5	a.	Derive the relation between bending stress and radius of curvature $\frac{\sigma}{y} = \frac{E}{R}$ .	6	L3	CO3
	b.	Define: i) Neutral axis ii) Section modulus	4	L2	CO3
	c.	A hollow propeller shaft of a steam ship is to transmit 3750 KW at 240 rpm. If the internal diameter is 0.8 times the external diameter and if the maximum shear stress developed is to be limited to 160 N/mm², determine the size of the shaft.	10	L3	CO4
		OR O			
Q.6	a.	Derive the torsion equation with usual notations.	8	L3	CO4
	b.	The unsymmetrical I-section shown in Fig.Q.6(b) is subjected to a shear force of 40 KN. Draw the shear stress variation diagram across the depth.	12	L3	CO3
		Fig.Q.6(b)			
	-	Module 4	т —		
Q.7	a.	Derive differential equation for beam deflection with usual notations.	8	L3	CO4
	b.	Determine the critical load for a hollow cast iron rectangular column of external dimensions 200 mm × 150 mm with the thickness of the metal being 25 mm. The height of the column is 6 m and both ends are fixed. Use Euler's formula and	12	L3	CO4
	5	compare the value with that obtained by using Rankine's formula taking $\sigma_c$ = 500 N/mm² and a = 1/1600, which of the above formula decides the safe crippling load?			
		OD			
Q.8	a.	Derive an expression for Euler's crippling load for both ends hinged columns with usual notations.	8	L3	CO4
	b.	Compute the mid-span and maximum deflection for the beam shown in	12	L3	CO4
		Fig. 0.8(b) Given $E = 210 \text{ GeV/m}^2$ and moment of inertia = $36000 \times 10^{-9} \text{ m}^4$		1/4	
		Fig.Q.8(b). Given E = 210 Givin and months of moths 30000 × 10 m.  4500N m  CMRIT LIBRARY  BANGALORE - 560 037			9%
		Fig.Q.8(b)  BANGALORE - 560 037			
		2 of 3			

٠

St. Ch.

				BC	V30.
		Module – 5			more and the second
Q.9	a.	With a neat sketch, explain the two-dimensional stress system.	8	L2	CO
	b.	A cylindrical shell is 3 m long and is having 1 m internal diameter and 15 mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the shell, if it is subjected to an internal fluid pressure of 1.5 N/mm <sup>2</sup> .	12	L3	CC
Q.10	a.	OR  Derive Lame's equation for radial and hoop stress for thick cylinder subjected to internal and external fluid pressure.	10	L3	CC
	b.	The direct stresses acting at a point in a strained material are shown in Fig.Q.10(b). Find the normal, tangential and resultant stresses on plane 30° to the plane of major principal stress. Find the obliquity of the resultant stress also.    80N mm <sup>2</sup>   129N mm <sup>2</sup>	10	L3	CC
		80N mm <sup>2</sup> Fig.Q.10(b)  RANSALORE - 560 037			
		CR CY CR			
	6	CR. CR. 3 of 3			

