CBCS SCHEME

USN | | | | | | | | | | |

BME301

Third Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Describe with a neat sketch, stress-strain diagram of mild steel and cast iron indicating salient points.	**05**	**L1**	**CO1**
	b.	State Hooke's law and determine an expression for shortening/extension of bar.	**05**	**L2**	**CO1**
	c.	The tensile test was conducted on a mild steel bar. The following data was obtained from the test: diameter of the steel bar = 16 mm; gauge length of the bar = 80 mm, load at proportionality limit = 72 kN, extension at a load of 60 kN = 0.115 mm, load at failure = 80 kN, final gauge length of the bar = 104 mm, diameter of the rod at failure = 12 mm. Determine: (i) Young's modulus (ii) Proportionality limit (iii) True breaking stress (iv) Percentage elongation	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Derive a relation between modulus of elasticity and bulk modulus.	**04**	**L2**	**CO1**
	b.	A member is of total length 2m, its diameter is 40 mm for the first 1m length. In the next 0.5 m length, its diameter gradually reduces from 40 mm to 'd' mm. For the remaining length of the member, the diameter remains 'd' mm uniform. When this member is subjected to an axial tensile force of 150 kN, the total elongation observed is 2.39 mm. Determine diameter 'd'. Assume Young's modulus = 2×10^5 MPa.	**08**	**L3**	**CO1**
	c.	A stepped bar of steel, held between two supports as shown in Fig.Q2(c) is subjected to loads P_1 = 80 kN and P_2 = 60 kN. Find the reaction developed at the ends A and B.	**08**	**L3**	**CO1**

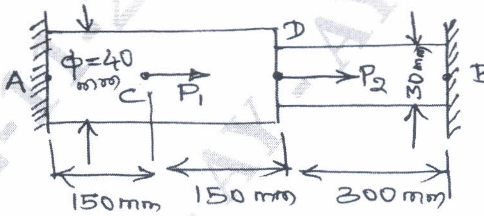
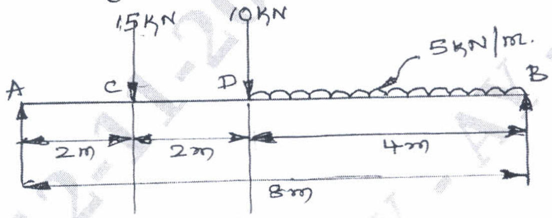
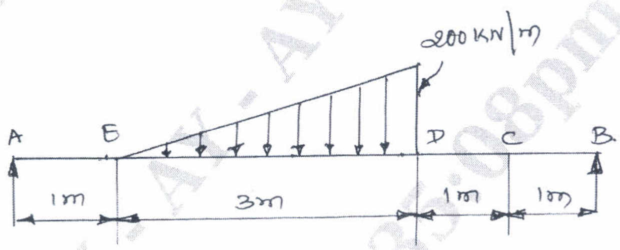
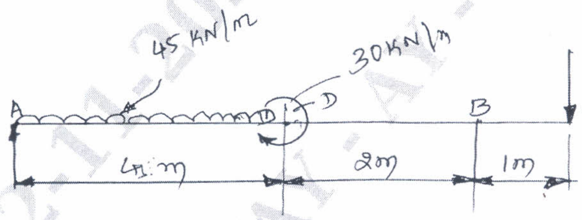
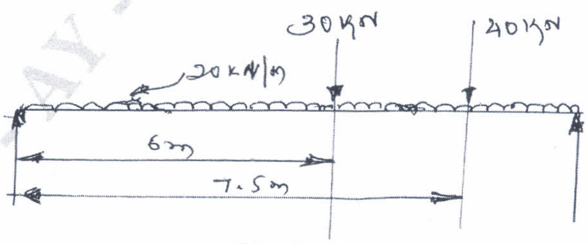
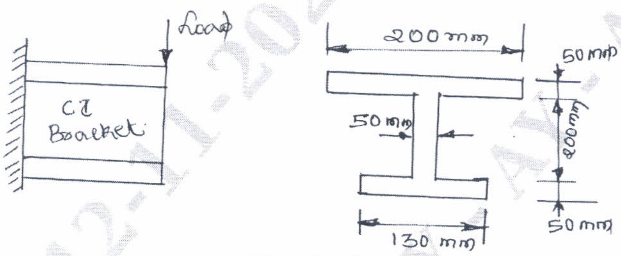


Fig.Q2(c)

		Module – 2			
Q.3	**a.**	Derive an expression for normal and shear stress on a inclined plane of a member subjected to bi-axial stress system.	**10**	**L2**	**CO2**
	b.	A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3 N/mm^2. The diameter of the cylinder is 25 cms and the length is 75 cms. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter length and volume of the cylinder. Take E = 2.1×10^5 MPa and 1/m = 0.286.	**10**	**L3**	**CO1**

		OR			
Q.4	**a.**	At a point in a loaded elastic member, there are normal stresses of 60 MPa and 40 MPa both tensile respectively, at right angles to each other with shearing stress of 20 MPa. Draw the Mohr's circle diagram and find out: (i) Principal stresses and their planes (ii) Maximum shear stress and its planes.	10	L4	CO2
	b.	Define thick and thin cylinders. Also derive an expression for circumferential stress in a thin cylinder.	10	L2	CO2
		Module – 3			
Q.5	**a.**	A simply supported beam of 10 m span as shown in the Fig.Q5(a) carries two concentrated loads and a uniformly distributed load. Draw shear force and bending moment diagram.  Fig.Q5(a)	10	L4	CO4
	b.	Draw the SFD and BMD for the beam loaded as shown in Fig.Q5(b). Also find the position of maximum bending moment and maximum bending moment.  Fig.Q5(b)	10	L4	CO4
		OR			
Q.6	**a.**	For a beam shown in Fig.Q6(a), determine the magnitude of the load acting at C, such that the reaction at support A and B are equal. Draw SFD and BMD indicating the values at the salient points. Locate point of contra flexure.  Fig.Q6(a)	10	L4	CO4
	b.	A simply supported beam is loaded as shown in Fig.Q6(b). Draw SFD and BMD for the beam and state the valves of maximum bending moment and maximum shear.  Fig.Q6(b)	10	L4	CO3

		Module – 4			
Q.7	**a.**	A simply supported beam having cross section of 20 mm × 20 mm fails when a central point load of 400 N is applied span of beam is 2m. What UDL will break a cantilever of same material 40 mm wide, 60 mm deep and 3m long.	**10**	**L3** **L4**	**CO2** **CO3**
	b.	A cast iron bracket subject to bending has the cross-section of I-form with unequal flanges. The dimension of the section are shown in Fig.Q7(b). Find the position of the Neutral axis and moment of inertia of the section about the neutral axis. If the maximum bending moment on the section is 40 MN-mm. Determine the maximum bending stress. What is the nature of the stress?  Fig.Q7(b)	**10**	**L3** **L4**	**CO1** **CO2**
		OR			
Q.8	**a.**	Derive an expression for bending stresses in beams.	**10**	**L2**	**CO1**
	b.	A 5m cantilever beam of cross-section 150 mm × 300 mm fails when a load of 30 kN is applied at the free end. Find the stress at failure.	**05**	**L3**	**CO2**
	c.	List assumptions made in pure bending theory.	**05**	**L1**	**CO1**
		Module – 5			
Q.9	**a.**	A solid shaft has to transmit 150 KW of power at 180 rpm. If allowable shear stress is 70 MPa and allowable angle of twist is 1° in a length of 4m. Find the suitable diameter of solid circular shaft. Take G = 84 GPa.	**10**	**L4**	**CO2**
	b.	Derive Euler's crippling load for a column when both its ends are hinged.	**10**	**L2**	**CO1**
		OR			
Q.10	**a.**	A 150 mm diameter solid steel shaft is transmitting 450 KW power at 90 rpm, compute the maximum shearing stress. Find the change that would occur in the shearing stress, if the speed were increased to 360 rpm.	**10**	**L4**	**CO2**
	b.	A 1.5m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, calculate the safe load using : (i) Rankine's formula taking yield stress 560 N/mm^2 and $a = \frac{1}{600}$ (ii) Euler's formula taking $E = 1.2 \times 10^5$ MPa	**10**	**L4**	**CO2**

* * * * *