BME301

Third semester B.E. Degree Examinations, March/April 2024

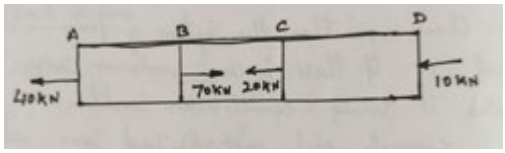
Mechanics of Materials

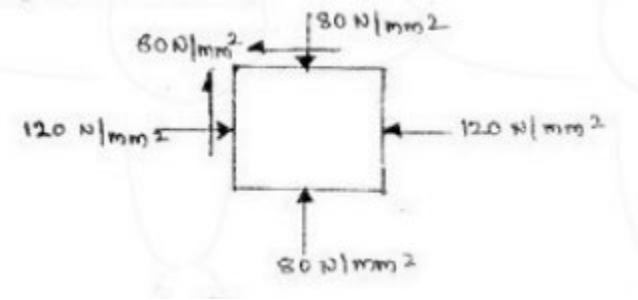
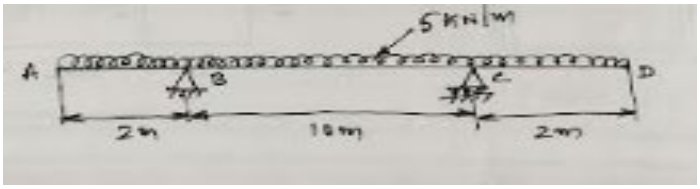
Model Question paper.

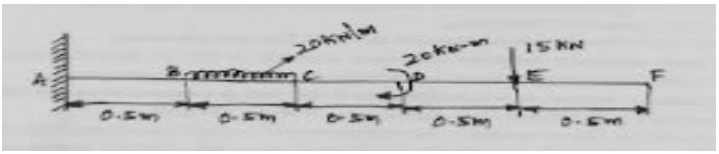
Time; 3 hrs. **Max. Marks; 100**

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.**	Define i) Young's modulus ii) Poisson's ratio iii) Secant modulus iv) Strain hardening	**4**	**L1**	**CO1**
	b.	Derive an expression for total deformation of a circular bar, when it is subjected to an axial force P	**6**	**L2**	**CO1**
	c.	A brass bar, having a cross-section area of 900 mm^2, is subjected to axial forces as shown in fig Q1 AB= 0.6m BC=0.8m and CD=1.0m. Find the total elongation of the bar. Take E= $1X10^5 N/mm^2$.  Fig Q1	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Derive an expression for relationship between Young's modulus, modulus of Rigidity and Poisson's ratio.	**10**	**L2**	**CO1**
	b.	Determine the change in length, breadth and thickness of a steel bar which is 5m long, 40 mm wide and 30mm thick and is subjected to an axial pull of 35KN in the direction of its length Take E= $2X10^5 N/mm^2$ and Poisson's ratio is 0.32.	**10**	**L3**	**CO1**
		Module-2			
Q.3	**a.**	Explain the meaning of principal lanes and principal stresses. What is the value of shear stress on principal planes?	**5**	**L2**	**CO2**

	b.	The state of stress in two dimensionally stressed bodies is as shown in fig Q3. Determine the Normal, Tangential stress, principal planes and principal stresses, maximum shear stress and their planes.  Fig Q3	**15**	**L3**	**CO2**
		OR			
Q.4	**a.**	Define, i) Circumferential stress, ii) Longitudinal stress for thin cylinders	**2**	**L1**	**CO2**
	b.	Derive the expression for Longitudinal stress in the thin cylinders	**6**	**L2**	**CO2**
	c.	A thick cylinder of radii 200mm and 300mm is subjected to internal fluid pressure 50 N/mm^2 and external fluid pressure of 20 N/mm^2. Determine Hoop stress developed in a internal and external radii. Sketch the variation of stress.	**12**	**L3**	**CO2**
		Module-3			
Q.5	**a.**	Briefly explain different types of beams supports.	**5**	**L2**	**CO3**
	b.	Draw SFD and BMD for the loading pattern on the beam shown in fig Q5. Indicate where point of contraflexure is located. Also locate the maximum BM with its magnitude.  Fig Q5	**15**	**L3**	**CO3**
		OR			
Q.6	**a**	Derive expression relating Load, shear force and Bending moment(M) with usual notations.	**8**	**L2**	**CO3**
	b	Draw SFD and BMD for the cantilever beam loaded as shown in figQ6.	**12**	**L3**	**CO3**

		 Fig Q6			
Module-4					
Q.7	**a.**	Prove the relations $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations.	**10**	**L2**	**CO4**
	b.	A simply supported beam 15mmX20mm is 1.5m long and it fails if a concentrated load of 425N is applied at its center. Determine UDL can break a cantilever beam of same material 50mmX 110mm in section and 2m long	**10**	**L3**	**CO4**
OR					
Q.8	**a.**	A cast iron bracket subjected to bending has a cross-section of I- Form. The total depth of section is 350mm and metal is 50mm thick throughout, the top flange is 250 mm wide and bottom flange is 150mm wide. Calculate the intensity of udl that can be supported by a cantilever beam of 3m span if max tensile stress is limited to 175MPa. Also find maximum compressive stress. Sketch the stress distribution.	**20**	**L3**	**CO4**
Module-5					
Q.9	**a**	Derive the torsion formula, in the standard form $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$ And list all the assumptions made while deriving the same.	**10**	**L2**	**CO5**
	b	Find the diameter of the shaft required to transmit 60 KW at 150 rpm if the maximum torque is 25% of the mean torque for a maximum permissible shear stress of 60MN/m^2. Also find the angle of twist for a length of 4m. Take G=80GPa.	**10**	**L3**	**CO5**
OR					
Q.10	**a**	Derive an expression for critical load in a column subjected to compressive load, when one end is fixed, and another end is free.	**10**	**L2**	**CO5**
	b	A 1.5m long column has a circular cross section of 50mm diameter. One of the ends of the column is fixed in direction and position and the other end is free. Take factor of safety as 3, calculate the safe load using. i) Rankine's formula, take yield stress=560 N/mm^2 and $\alpha=\frac{1}{1600}$ for a pinned end. ii) Euler's formula, Young's modulus for C.I.=1.2x10^5 N/mm^2.	**10**	**L3**	**CO5**