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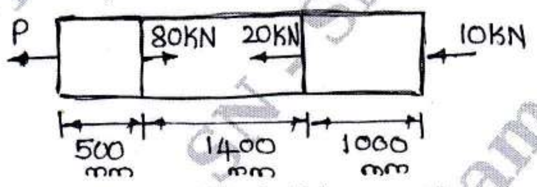
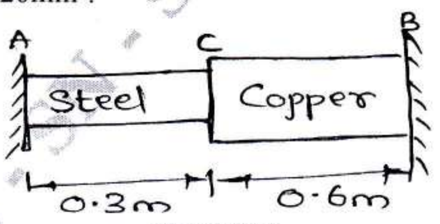
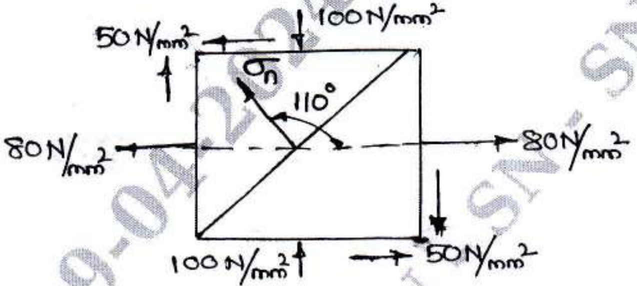
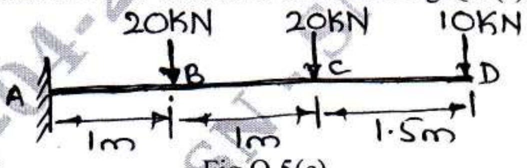
Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	State Hooke's law. Draw a neat diagram of stress-stain curve for mild steel and mark the salient points and zones.	5	L2	CO1
	b.	Derive an expression for elongation in a tapered bar of circular cross-section, subjected to an axial tensile load "F".	7	L3	CO1
	c.	A brass bar having uniform cross-section area of $300mm^2$ is subjected to a load as shown in Fig.1(c). Find the total elongation of bar and the magnitude of load "P" if, E = 84GPa.  Fig.Q.1(c)	8	L3	CO1
		OR			
Q.2	a.	Define the following: i) Poisons ratio ii) Bulk modulus iii) Factor of safety iv) True stress v) Hardness.	5	L2	CO1
	b.	A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and elastic constants E, G, K.	7	L3	CO1
	c.	A stepped bar is fixed at its two ends rigidly. The bar is free from stresses when its temperature is 30°C. When the temperature is increased to 90°C, determine: i) Stresses induced in copper and steel portions. ii) Displacement at the junction point "C". Take $E_c = 100GPa$, $E_s = 200GPa$, $\alpha_c = 1.8 \times 10^{-5}/°C$ and $\alpha_s = 1.2 \times 10^{-5}/°C$, $A_s = 80mm^2$, $A_c = 120mm^2$.  Fig.Q.2(c)	8	L3	CO1

Module – 2

			Marks	L	CO
Q.3	a.	Define: i) Principal plane ii) Principal stress iii) Maximum shear stress iv) Plane of maximum shear.	8	L2	CO2
	b.	An element with the stresses acting on it is shown in Fig.Q.3(b), by Mohr's circle method find: i) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to x-axis ii) Principal stresses and their locations. iii) Maximum shear stresses and their locations.  Fig.Q.3(b)	12	L3	CO2
		OR			
Q.4	a.	Derive expressions for circumferential and longitudinal strains in thin cylinder. Hence show that volumetric strain is $\in_v = \frac{pd}{4tE}(5-4\gamma)$	8	L3	CO2
	b.	A cast iron pipe has 200mm internal diameter and 50mm metal thickness. It carries water at a pressure of 5N/mm². Calculate the intensities of circumferential and radial pressures. Sketch the stress distribution across the section.	12	L3	CO2
		Module – 3			
Q.5	a.	Discuss about different types of beams and loads.	6	L2	CO3
	b.	Obtain a relation between load intensity, shear force and bending moment.	6	L3	CO3
	c.	Draw the BMD and SFD for cantilever shown in Fig.Q.5(c).  Fig.Q.5(c)	8	L3	CO3
		OR			
Q.6	a.	Define: i) Point of contraflexure ii) Bending moment iii) Shear force.	6	L2	CO3

	b.	A simply supported beam is shown in Fig.Q.6(b). Draw the SFD and BMD.	**14**	**L3**	**CO3**

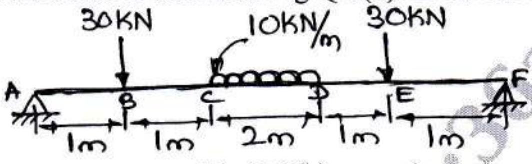


Fig.Q.6(b)

Module – 4

Q.7	**a.**	List the assumptions made in theory of pure bending. Derive the bending equation with usual notations.	**10**	**L3**	**CO4**
	b.	A simply supported beam of 5m span has a cross-section 150mm × 250mm. If the permissible stress is 10N/mm^2. Find: i) Maximum UDL intensity ii) Maximum concentrated load "P" at 2m from one end.	**10**	**L3**	**CO4**

OR

Q.8	**a.**	A uniform I-section beam is subjected 100kNm bending moment. Plot the stress variation across the section.	**10**	**L3**	**CO4**

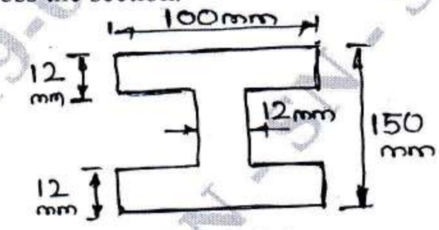


Fig.Q.8(a)

	b.	A cantilever of square section 200mm × 200mm and length 2m, fails in flexure when 12kN is placed at free end. A rectangular beam of same material and simply supported over length of 3m, 150mm wide and depth 300mm. Calculate minimum central concentrated load required to break the beam.	**10**	**L3**	**CO4**

Module – 5

Q.9	**a.**	Derive torsion equation. Also list the assumptions.	**10**	**L3**	**CO5**
	b.	Find the shaft diameter required to transmit 60kW at 150rpm, if maximum torque is 25% more than mean torque for a maximum shear stress of 60MPa. Find angle of twist for a 4m length. 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 fixed and other free.	**10**	**L3**	**CO5**
	b.	A 1.5m long column has a circular cross-section of 50mm diameter. One end of column is fixed and other end is free. Taking FOS = 3. Calculate safe load using i) Rankines formula, yield stress 560N/mm^2 and $a = \frac{1}{1600}$ ii) Eulers formula, E = 120GPa.	**10**	**L3**	**CO5**

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