U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 19ME3DCSOM **Max Marks: 100**
Course: Strength of Materials

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Derive the relationship between the elastic constants E, G, K and μ.	*CO1*	*PO1*	**10**
	b)		A compound bar is made of a central steel plate 60 mm wide and 10 mm thick to which copper plates of 40 mm wide by 5 mm thick are attached rigidly on each side. The length of the bar at normal temperature is 1 meter. If the temperature is raised by 80^{o}C, determine the stresses in each metal and the change in length, provided E_s=200 GPa, Ec=100 GPa, α_s=12x10^{-6}/^{o}C, α_c=17x10^{-6}/^{o}C.	*CO2*	*PO2*	**10**
			OR			
2	a)		Prove that the sum of normal stresses in any two mutually perpendicular directions is constant.	*CO1*	*PO2*	**8**
	b)		The state of stress at a point in a strained material is given as σ_x=180 N/mm^2, σ_y=120 N/mm^2, shear stress (clockwise) = 80 N/mm^2. Determine graphically the direction & magnitude of principal stresses, direction and magnitude of maximum shear stresses.	*CO2*	*PO2*	**12**
			UNIT - II			
3	a)		Draw the shear force and bending moment diagrams of a simply supported beam considering the self-weight of the beam. Hint: Consider self-weight as UDL.	*CO2*	*PO2*	**10**
	b)		Draw the shear force and bending moment diagrams of a 3. 5 m long left supported cantilever beam subjected to point loads 10 kN, 20 kN and 20 kN acting at the free end, 1.5 m and 2.5 m respectively from the free end.	*CO2*	*PO2*	**10**
			UNIT - III			
4	a)		Derive the flexural equation of a beam having very small deflections when loaded laterally.	*CO3*	*PO2*	**10**

		b)	Prove that the maximum shear stress in a rectangular beam is 1.5 times the average shear stress.	*CO3*	*PO2*	**10**
			OR			
	5	a)	Determine the mid-span deflection of a simply supported beam subjected to a central point load, P, having Young's modulus, E and moment of inertia, I.	*CO3*	*PO2*	**10**
		b)	A simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m from left end. Determine i) the position and the value of maximum deflection, ii) slope at mid-span, iii) deflection at the load point. Given E = 200GPa, I=15x$10^6$$mm^4$	*CO3*	*PO2*	**10**
			UNIT - IV			
	6	a)	Determine the diameter of solid shaft which will transmit 440 kW at 280 rpm. The angle of twist must not exceed one degree per metre length and the maximum torsional shear stress is to be limited to 40 N/mm^2. Assume G = 84 kN/mm^2.	*CO4*	*PO2*	**10**
		b)	Determine the percentage of savings in material when a hollow shaft with external diameter twice the internal diameter is used in place of a solid shaft transmitting 245 kW power at 240 rpm. The maximum torque is 1.5 times the mean torque. Maximum allowable shear stress is 40 N/mm^2 and the angle of twist must not exceed one degree per metre length. Take G = 80 GPa.	*CO4*	*PO2*	**10**
			UNIT - V			
	7	a)	Obtain the dimensional changes in a thin cylinder of diameter d, length L, subjected to an internal fluid pressure, P.	*CO5*	*PO2*	**10**
		b)	Why is Rankine's load more useful than Euler's buckling load? Explain with an example.	*CO5*	*PO2*	**10**

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