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

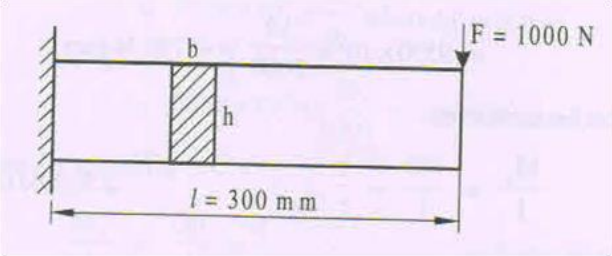
Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 19ME4DCDM1 **Max Marks: 100**
Course: Design of Machine Elements – I

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Design data handbook is permitted.

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)	Briefly explain design codes and standards.	CO1	PO1	**04**
	b)	A beam of uniform rectangular cross-section shown in **Fig. Q1b** is fixed at one end and carries a load 1000 N at a distance of 300 mm from the fixed end. The maximum bending stress in the beam is 80 N/mm^2. Find the width and depth of beam if depth is twice as that of width.  **Fig.Q1b**	CO1	PO2	**06**
	c)	A cantilever beam of span 800 mm has a rectangular cross section of depth 200 mm. The free end of the beam is subjected to a transverse load of 1 kN that drops on to it from a height of 40 mm. Selecting 40C8 steel (σ_{yt} = 328.6 MPa) and factor of safety = 3, determine the width of rectangular cross section. Take E= 206 GPa.	CO1	PO2	**10**
		OR			
2	a)	Show the triaxial stress component on an element and also give the stress tensor.	CO1	PO1	**04**
	b)	A rod of circular section is to sustain a torsional moment of 300 kN-m and bending moment 200 kN-m. Selecting 45C8 steel (σ_{yt} = 353 MPa) and assuming factor of safety = 3, determine the diameter of the rod as per the following theories of failure: (i) Maximum shear stress theory, & (ii) Distortion energy theory.	CO1	PO2	**08**
	c)	A beam of 300 mm depth 'I' section is resting on two supports			**08**

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			5 m apart. It is loaded by a weight of 5000 N falling through a height 'h' and striking the beam at midpoint. Moment of inertia of the section is 9.6×10^7 mm^4. Modulus of elasticity E = 21×10^4 N/mm^2. Determine the permissible value of 'h' if the stress is limited to 130 N/mm^2.			
			UNIT - II			
	3	a)	Derive the Goodman's equation for infinite life under fatigue loading.	*CO2*	*PO1*	**06**
		b)	A round rod of diameter 1.2d is reduced to a diameter d with a fillet radius of 0.1d. This stepped rod is to sustain a twisting moment that fluctuates between + 2.5 kN-m and + 1.5 kN-m together with a bending moment that fluctuates between + 1 kN-m and – 1 kN-m. The rod is made of carbon steel C40 (σ_y = 328.6 MPa; σ_u = 620 MPa). Determine a suitable value of d taking the endurance limit as half the ultimate strength and factor of safety as 2.	*CO2*	*PO2*	**14**
			UNIT - III			
	4	a)	Write the ASME code for shaft design.	*CO3*	*PO1*	**04**
		b)	A horizontal piece of commercial shafting is supported by two bearings 1.5 m apart. A keyed gear 20^0 involute and 175 mm in diameter is located 400 mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1, with the slack side on top. The drive transmits 45 kW at 330 rpm. Take $K_b = K_t = 1.5$. Calculate the necessary diameter of the shaft and angular deflection in degrees. Take allowable shear stress as 40 MPa and G = 80×10^9 N/m^2.	*CO3*	*PO3*	**16**
			OR			
	5	a)	Design a socket and spigot type of cotter joint to connect two rods of 30C8 steel to carry an axial load of 100 kN. The allowable stresses are σ_t = 90 MPa; σ_c = 100 MPa and τ =50 MPa.	*CO3*	*PO3*	**10**
		b)	Design a protected type flange coupling to transmit 24 kW at 300 rpm. The allowable shear stress in the shaft and key material is 40 MPa. The maximum torque transmitted is to be 25% greater than the full load torque. The allowable shear stress in the bolt material is 60 MPa and allowable shear stress in the flange is 40 MPa.	*CO3*	*PO3*	**10**
			UNIT - IV			
	6	a)	Design a double riveted butt joint with two equal width cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume an efficiency of 75%, allowable tensile stress in the plate of 90 N/mm^2, allowable crushing stress of 140 N/mm^2 and an allowable shear stress in the rivet of 56 N/mm^2.	*CO3*	*PO3*	**10**

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		b)	A plate of 80 mm width and 10 mm thickness is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that maximum stress does not exceed 50 N/mm^2. Consider the joint under static loading and then under dynamic loading.	*CO3*	*PO2*	**10**
			UNIT - V			
	7	a)	Explain the various types of stresses in threaded fasteners.	*CO3*	*PO1*	**06**
		b)	A single start square threaded power screw is used to raise a load of 120 kN. The screw has a mean diameter of 24 mm and four threads per 24 mm length. The mean collar diameter is 40 mm. The coefficient of friction is 0.1 for both the thread and the collar. Determine: (i) Major diameter of the screw, (ii) Screw torque required to raise the load, (iii) Overall efficiency & (iv) If collar friction is eliminated, what minimum value of thread coefficient is required to prevent the screw from overhauling ?	*CO3*	*PO2*	**14**

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