U.S.N.										

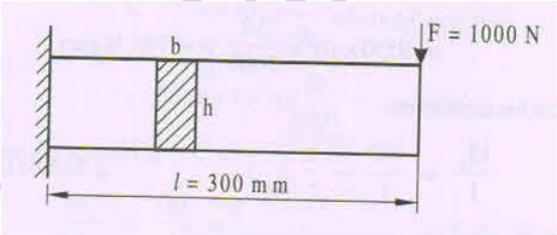
B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME4PCDM1 **Max Marks: 100**
Course: Design of Machine Elements - 1

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

		UNIT - I	CO	PO	Marks
1	a)	Briefly explain design codes and standards.	CO1	PO 1	**4**
	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	**6**
	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)	Explain the following theories of failure: (i) Maximum normal stress theory and (ii) Maximum shear stress theory.	CO1	PO 1	**4**
	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	**8**

		c)	A beam of 300 mm depth 'I' section is resting on two supports 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.	*CO1*	*PO2*	**8**
			UNIT - II			
	3	a)	Derive the modified Soderberg equation with usual notations	*CO2*	*PO1*	**6**
		b)	A circular bar of 500 mm length is supported freely at its two ends. It is acted centrally by a concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of the bar by taking a factor of safety of 1.5, size factor of 0.85, surface finish factor of 0.9. The material properties of the bar are given by: ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.	*CO2*	*PO2*	**14**
			UNIT - III			
	4	a)	Write the ASME code for shaft design.	*CO3*	*PO1*	**4**
		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*	*PO1*	**16**
			OR			
	5	a)	Show that a square key is equally strong in compression and shear.	*CO3*	*PO1*	**5**
		b)	A standard splined connection 6x48x54 mm is used for gear and shaft assembly of a gear box. 12 kW of power at 1400 rpm is transmitted by the splined connection. Limiting the normal pressure on the spline to 6 N/mm^2. Determine the length of the hub of the gear.	*CO3*	*PO1*	**5**
		c)	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 to connect two plates of 20 mm thick. The joint is zig-zag riveted and has equal width cover plates. The allowable tensile stress for the plate is 100 MPa. The	*CO3*	*PO3*	**10**

			allowable shear and crushing stresses for rivet material are 60 MPa and 120 MPa respectively. Calculate the efficiency of the joint. The joint should be leak proof.			
		b)	A plate of 80 mm wide and 15 mm thick is joined with another plate by a single transverse weld and a double parallel weld. Determine the length of parallel fillet weld if the joint is subjected to both static and fatigue loading. Take σ_t = 90 MPa and τ = 55 MPa as the allowable stresses. Take maximum tensile load as equal to the strength of plate.	*CO3*	*PO2*	**10**
			UNIT - V			
	7	a)	Explain the various types of stresses in threaded fasteners.	*CO3*	*PO1*	**6**
		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**

****