U.S.N.										

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

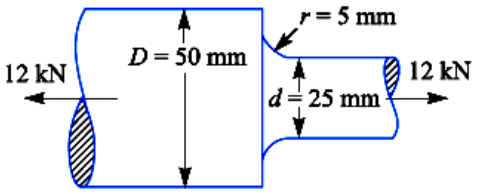
Autonomous Institute Affiliated to VTU

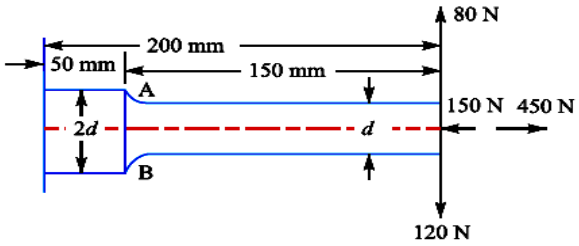
October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 23IM4ESDME **Max Marks: 100**
Course: Design of Machine Elements

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 Hand Book 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)	Draw the stress strain diagram for a mild steel specimen & mention the salient points.	CO1	PO1	04
	b)	Find the maximum stress induced in the stepped shaft as shown in figure shown below taking stress concentration into account, carrying a tensile load of 12 kN. 	CO1	PO1	06
	c)	State the three theories of failure with the design equations.	CO1	PO1 PO2 PO4	10
		OR			
2	a)	A steel cantilever is 200 mm long. It is subjected to an axial load which varies from 150 N (compression) to 450 N (tension) and also a transverse load at its free end which varies from 80 N up to 120 N down. The cantilever is of circular cross-section. It is of diameter 2d for the first 50 mm and of diameter d for the remaining length. Determine its diameter taking a factor of safety of 2. Assume the following values: Yield stress = 330 MPa Endurance limit in reversed loading = 300 MPa Correction factors = 0.7 in reversed axial loading = 1.0 in reversed bending Stress concentration factor = 1.44 for bending = 1.64 for axial loading	CO2	PO1	12

			Size effect factor = 0.85 Surface effect factor = 0.90 Notch sensitivity index = 0.90 			
		b)	Derive the Soderberg relation subjected to reversed bending load.	*CO2*	***PO1*** ***PO2*** ***PO4***	**08**
	UNIT – II					
	3	a)	Design a sleeve coupling to transmit 10 kW at 200 rpm. The allowable values for the shaft and key material may be taken as 60 N/mm^2 and 130 N/mm^2 respectively. Use allowable shear stress in cast iron sleeve equal to 15 N/mm^2.	*CO3*	***PO1*** ***PO2*** ***PO4***	**10**
		b	Design a socket and spigot type cotter joint to sustain an axial tensile load of 80000 N. The material selected for the joint is C-40 Steel. Take FOS of 1.75.	*CO3*	***PO1*** ***PO2*** ***PO4***	**10**
			UNIT – III			
	4	a)	Design a pair of spur gears to transmit a power of 18 kW from a shaft rotating at 1200 rpm to a parallel shaft to be run at 450 rpm maintaining a distance of 160 mm between the centre lines of the shaft. The pinion has 18 teeth cut on it & is made of C-30 Steel with design stress of 220.6 MPa. The gear is made of forged steel about 0.30% C untreated having a design stress of 172.6 MPa.	*CO 2*	***PO1***	**12**
		b)	Derive the Lewis equation for the beam strength of gear teeth.	*CO1*	***PO1*** ***PO2***	**08**
			UNIT – IV			
	5	a)	Determine the diameter of a hollow shaft to transmit a power of 80 kW at a rated speed of 1000 rpm and sustain a bending moment of 25N-m, limiting the twist to 1.5º in a length of 800 mm. Material selected for the shaft has a design shear stress of 75 MPa. Ratio of the diameter should be 0.7. Modulus of Rigidity (G) = 82.7GPa.	*CO3*	***PO1*** ***PO2*** ***PO4***	**10**
		b)	A steel spindle transmits 5 HP at 800 rpm. The angular deflection should not exceed 1.5º per meter length of the spindle. The rigidity modulus G = 8.4 x 10^3 MPa. Find the diameter of the spindle and shear stress induced in the shaft.	*CO3*	***PO1*** ***PO2*** ***PO4***	**10**
			OR			
	6	a)	A mild steel shaft transmits 29 kW at 200 rpm. It carries a central load of 2000 N and is simply supported between bearings 1.5 m apart. Determine the commercial size of the shaft if the allowable shear stress for the material is 60 MPa.	*CO3*	***PO1*** ***PO2*** ***PO4***	**10**

		b)	A solid shaft is subjected to a maximum torque of 100 N-m and a maximum bending moment of 150 N-m. The shaft is subjected to minor shocks and is made up of commercial steel for which the yield stress is 300 MPa. Determine the size of the shaft required assuming a factor of safety of 2.5.	*CO3*	***PO1*** ***PO2*** ***PO4***	**10**
			UNIT – V			
	7	a)	Determine the power loss for a Petroff bearing 100 mm in diameter and 150 mm long. The radial clearance is 0.05 mm. Speed of the journal is 1000 rpm. The lubricating oil is SAE 10 and bearing operating temperature is 60℃.	*CO4*	***PO1*** ***PO2*** ***PO4***	**10**
		b)	Derive Petroff's equation.	*CO1*	***PO1*** ***PO2***	**10**

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