U.S.N.										

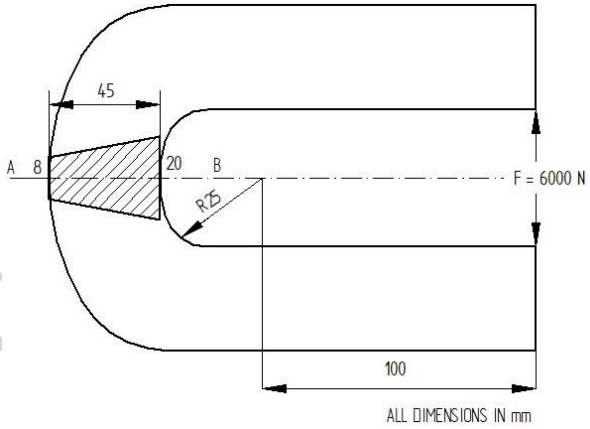
B.M.S. College of Engineering, Bengaluru-560019

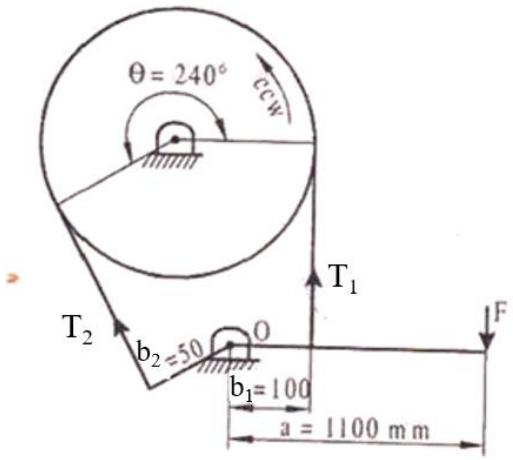
Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCDM2 **Max Marks: 100**
Course: Design of Machine Elements - 2

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 Machine Data Handbook is permitted.

			UNIT - I	*CO*	*PO*	Marks
1	a)		Derive the stress equation in case of a curved beam using standard notations and also state the assumptions.	*CO1*	*PO1*	**08**
	b)		The frame of a punch press is shown in Fig. 1. Find the stress in inner and outer surfaces at section A–B of the frame if F= 6000 N.  Fig. 1.	*CO1*	*PO2*	**12**
			OR			
2	a)		Develop an expression for maximum shear stress induced in the wire of a helical compression spring subjected to an axial compressive force.	*CO1*	*PO1*	**08**
	b)		A loaded narrow gauge car weighs 18 kN and moving at a velocity of 80 m/min is brought to rest by a buffer consisting of 2 helical springs. In bringing the car to rest the spring undergoes a compression of 200 mm. The allowable shear stress is 0.3 GPa and the spring index is 8. Design a suitable spring taking modulus of rigidity as 84 GPa.	*CO1*	*PO2*	**12**

			UNIT - II			
	3	a)	Design a single plate clutch used in automobile transmission, assuming uniform wear condition for the following specifications: Power to be transmitted = 20 kW; speed = 1500 rpm; Friction surface moulded asbestos on steel. Assume both sides of the friction plate as effective. Take C40 steel (σ_y = 328.6 MPa) as shaft material and factor of safety as 3.	*CO2*	*PO2*	**08**
		b)	A differential band brake shown in Fig. 2 operates on a drum diameter of 500mm. The drum rotates at 300 rpm in counter clockwise direction and absorbs 36 kW. Coefficient of friction is 0.25. Determine: (i) Force F required to operate the brake, (ii) Width of band required for this brake if thickness is 5 mm and allowable tensile stress on band material is 72 N/mm^2 and (iii) Design the lever if the maximum force is twice that of calculated force. Use C30 steel and FOS = 4 based on ultimate stress of 540 MPa. Assume rectangular cross-section for the lever depth equal to thrice the width.  Fig. 2 (All dimensions in mm)	*CO2*	*PO2*	**12**
			UNIT - III			
	4	a)	Derive an expression for beam strength of a spur gear tooth using standard notations.	*CO3*	*PO1*	**05**
		b)	Design a bronze spur gear (σ_0 = 81.4 MN/m^2) and mild steel pinion (σ_0 = 101 MN/m^2) to transmit 5 kW at 1800 rpm. The velocity ratio is 3.5:1. Pressure angle is 14 $^{1/2}0$. The number of teeth on pinion is 16. Determine the module and face width if face width is ten times the module. Also suggest suitable hardness for the weaker member based on dynamic and wear considerations. Take service factor C_s = 1.5.	*CO3*	*PO3*	**15**
			OR			
	5	a)	Obtain an expression for formative number of teeth for a bevel gear.	*CO3*	*PO1*	**05**

		b)	Design a pair of bevel gears to transmit 12 kW at 300 rpm of the gear and 1470 rpm of the pinion. The angle between the shaft axes is 90^0. The pinion has 20 teeth and the material for gears is cast steel (σ_o = 183.33 N/mm^2). Take service factor as 1.25 and check the gears for wear and dynamic load. Suggest suitable surface hardness for the gear pair.	*CO3*	*PO3*	**15**
			UNIT - IV			
	6	a)	Derive the Petroff's equation used to determine the coefficient of friction in the design of journal bearings.	*CO4*	*PO1*	**06**
		b)	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 mm. The lubricating oil is SAE 10 and bearing operating temperature is 60^0 C.	*CO4*	*PO2*	**04**
		c)	A hydrodynamic journal bearing of diameter 75 mm and length 75 mm is lubricated using SAE 20 oil. The oil enters at 40^0 C and the journal rotates at 1200 rpm. The diametral clearance is 0.075 mm. Assume operating temperature of the oil as 53^0 C. Determine: (i) magnitude and location of the minimum film thickness, (ii) power loss, (iii) oil flow through the bearing with side leakage.	*CO4*	*PO3*	**10**
			UNIT - V			
	7	a)	Select a V - belt drive to transmit 10 kW of power from a pulley of 200 mm pitch diameter mounted on an electric motor running at 720 rpm to another pulley mounted on compressor running at 200 rpm. The service is heavy duty varying from 10 hours to 14 hours per day and center distance between center of pulleys is 600 mm.	*CO5*	*PO2*	**10**
		b)	A 20 mm, 8 x 19 steel wire rope is used with a hoisting drum of 1 m diameter to lift a load of 20 kN. The depth of the mine is 800 mm and the acceleration is 3 m/s^2. Determine the number of ropes required using a factor of safety 5. Neglect the weight of skip. Take modulus of elasticity of rope as 82728 MPa.	*CO5*	*PO2*	**10**

****