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

Autonomous Institute Affiliated to VTU

July 2024 Semester End Main 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.

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)	Determine an expression for bending stress associated with the extreme fibers of a curved beam with usual notations and assumptions.	CO1	PO1	**10**
	b)	A crane hook has a rectangular section of width 30 mm and depth 60 mm. The center of curvature is at a distance of 125 mm from the inside section and the load line is 100 mm from the same point. Determine the capacity of the crane hook if the allowable stress in tension is 75 MPa.	CO1	PO2	**10**
		OR			
2	a)	A load of 2000 N is dropped axially on a closed coiled helical spring from a height of 250 mm. The spring has 20 effective turns and it is made of 25 mm diameter wire. Find the maximum shear stress produced in the spring and the amount of compression produced. Assume (spring index) c = 8 and G = 84 GPa.	CO1	PO2	**10**
	b)	Determine the width and thickness of a flat spring carrying a central load of 5000 N. The deflection is limited to 100 mm. The spring is supported at both ends at a distance of 800 mm. The allowable stress is 300 MPa and modulus of elasticity is 221 GPa. The spring is of constant thickness and varying width.	CO1	PO2	**10**
		UNIT - II			
3	a)	Derive an expression for the torque transmitting capacity of a single plate clutch using uniform pressure theory.	CO2	PO1	**06**
	b)	A multi-plate clutch made up of steel on bronze clutch plates is used to transmit 8 kW at 1440 rpm. The inner diameter of the contact is 80 mm and the outer diameter of contact is 140 mm. The clutch operates in oil with average coefficient of friction as 0.1 and the average allowable pressure of 0.35 MPa. Assume	CO2	PO2	**06**

			uniform wear theory and determine the following (i) Number of steel and bronze plates, and (ii) Axial force required.			
		c)	Derive expressions for operating force of a simple band brake considering both clockwise and counter-clockwise direction of rotation of the drum written in terms of angle of lap, coefficient of friction, and lever dimensions.	*CO2*	*PO1*	**08**
			UNIT - III			
	4	a)	Develop an expression for the beam strength of a spur gear tooth with standard notations and a neat sketch.	*CO3*	*PO1*	**10**
		b)	A spur gear pinion with 100 mm pitch circle diameter transmits a torque of 200 Nm. The pressure angle of the involute gear-pinion pair is 20 degrees. Determine (i) Tangential force, (ii) Radial or separating force and (iii) Torque on the gear. Draw the free body diagram of the pinion gear pair showing radial and tangential forces with direction of rotation of gear pairs. Assume service factor as unity.	*CO3*	*PO2*	**10**
			OR			
	5	a)	Derive an expression for the formative number of teeth associated with a bevel gear.	*CO3*	*PO1*	**08**
		b)	The following data refer to a worm and worm gear drive, a) center distance between shafts is 200 mm, b) pitch circle diameter of the worm 80 mm, c) number of start is 4, d) axial module is 8 mm, e) transmission ratio is 20, f) the worm gear is made of phosphor bronze with an allowable bending stress of 55 MPa, g) the worm is made of hardened and ground steel, h) 20 degrees full depth involute. Determine the following: a) number of teeth on the worm gear, b) lead angle, c) face-width of worm gear to transmit 15 kW of power at 1750 rpm of the worm based on the beam strength of the worm gear.	*CO3*	*PO2*	**12**
			UNIT - IV			
	6	a)	Derive Petroff's equation for a lightly loaded bearing with suitable assumptions.	*CO4*	*PO1*	**8**
		b)	Design a journal bearing for a centrifugal pump running at 1200 rpm. Diameter of journal is 100 mm and load on bearing is 15 kN. Take L/d as 1.5, bearing temperature as 50^{o}C and ambient temperature is 30^{o}C. Determine whether artificial cooling is required.	*CO4*	*PO3*	**12**
			UNIT - V			
	7		Select a V-belt drive for connecting a 15 kW, motor at a rated speed of 2880 rpm to a centrifugal pump, running at 2400 rpm, providing 18 hours per day service. The center distance is approximately 400 mm. Assume the pitch diameter of the driving pulley as 125 mm.	*CO5*	*PO2*	**20**

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