U.S.N.										

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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Mechanical Engineering **Duration: 3 hrs.**

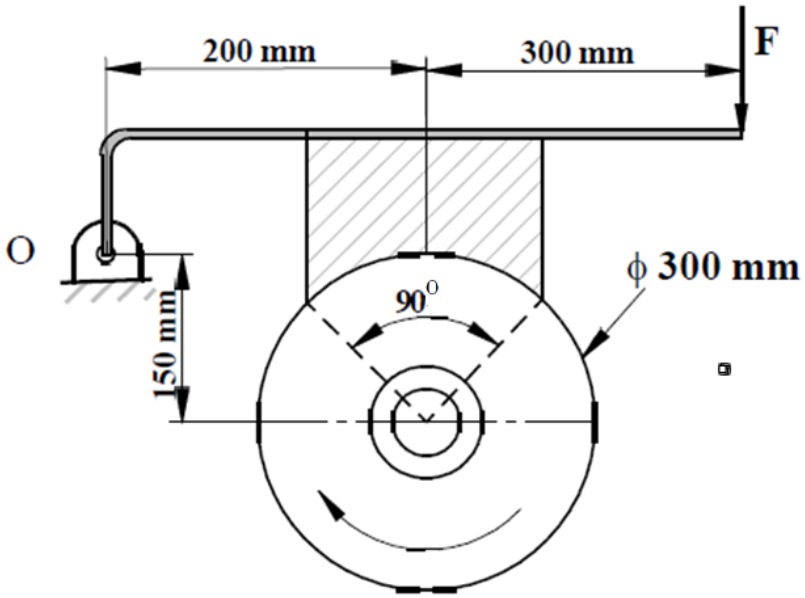
Course Code: 23ME5PCDM2 / 22ME5PCDM2 **Max Marks: 100**

Course: Design of Machine Elements 2

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

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)	Derive an expression for stress distribution due to bending moment in a curved beam. Also list out the assumptions made while deriving the equation.	*CO1*	*PO1*	**10**
	b)	A crane hook of trapezoidal cross section ½(90+40)120, has center of curvature at 100 mm from inner fibre & load line at 125 mm from the same point. Determine the maximum load capacity of the hook if the stress is not to exceed 120 Mpa.	*CO1*	*PO1*	**10**
		OR			
2	a)	Derive an expression for the shear stress induced in a helical compression spring, with usual notations.	*CO1*	*PO1*	**08**
	b)	A locomotive spring has an overall length of 1100 mm and sustain a load of 75 kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band 100 mm wide. All the leaves are to be stressed to 0.4 Gpa when fully loaded. The ratio of total spring depth to width is 2. Determine (i) Width & thickness of leaves (ii) nip or clearance to be provided (iii) Load exerted on the band by the clip bolt after assembly. Take E=206.8 Gpa	*CO1*	*PO3*	**12**
		UNIT - II			
3	a)	***Discuss*** briefly the merits & demerits of friction materials used in clutches.	*CO2*	*PO1*	**10**
	b)	A multiple disc clutch is composed of 5 steel and 4 bronze disks. The clutch is required to transmit a torque of 250N-m. ***Calculate*** the diameters of friction lining, if intensity of pressure is 0.25 MPa and coefficient to friction is 0.3. Assume that the maximum torque is 25% more than the mean torque. Take ratio of diameters as 0.6 and adopt uniform wear theory	*CO2*	*PO3*	**10**

			OR			
	4	a)	The block type hand brake shown in fig has a face width of 45mm. The friction material permits a maximum pressure of 0.6 Mpa and coefficient of friction of 0.24. Determine: i. Effort, F ii. Maximum torque absorbed by the brake iii. Heat generated if the speed of the drum is 100rpm and the brake is applied for 5sec to stop the drum.  	*CO2*	*PO3*	**10**
		b)	A simple band brake of drum diameter 600mm has a band passing over it with an angle of contact of 225°, while one end is connected to the fulcrum, the other end is connected to the brake lever at a distance of 400mm from the fulcrum. The brake lever is 1m long. The brake is to absorb a power of 35KW at 200rpm. Design the brake lever of rectangular cross section, assuming depth to be thrice the width. Take allowable stress to be 80Mpa and coefficient of friction as 0.25.	*CO2*	*PO2*	**10**
			UNIT - III			
	5		Design a pair of spur gears to transmit 12KW at 1000rpm of pinion with a velocity ratio 2.5. The design should be as compact as possible.	*CO3*	*PO3*	**20**
			OR			
	6		Design a pair of bevel gears to transmit 12 KW at 300 rpm of the gear & 1470 rpm of the pinion. The angle between the shaft axes is 90°. The pinion has 20 teeth and the material for gears is cast steel (σd=183.33 N/mm2), BHN 320. Take service factor as 1.25 and check the gears for wear & dynamic load. suggest suitable surface hardness for the gear pair	*CO3*	*PO3*	**20**
			UNIT - IV			
	7	a)	List out the important functions of lubricant in bearings.	*CO4*	*PO1*	**04**
		b)	Explain the following terminologies of journal bearing. i) l/d ratio ii) Radial clearance iii) Eccentricity iv) Attitude	*CO4*	*PO1*	**08**

		c)	Derive Petroff's equation for coefficient of friction. Also list out the assumptions made while deriving the Petroff's equation	*CO4*	*PO1*	**08**
			OR			
	8	a)	A turbine shaft 60mm in diameter rotates at a speed of 1000rpm. The load on each bearing is estimated to be 2KN and the length of the bearing is 80mm. Taking radial clearance as 0.05mm and SAE 20 oil for lubrication, determine the coefficient of friction, power loss, minimum oil film thickness and the oil flow rate necessary to dissipate the heat. The temperature of the bearing is not to exceed 50°C and ambient temperature may be assumed to be 25°C.	*CO4*	*PO2*	**12**
		b)	Design a journal bearing for a centrifugal pump running at 1200rpm. The load on the bearing is 15KN. Bearing temperature is 50°C and the ambient temperature is 30°C.	*CO4*	*PO3*	**08**
			UNIT - V			
	9	a)	A compressor, requiring 90kW, is to run at 250rpm. The drive is by V-Belts from an electric motor running at 750rpm. The diameter of the pulley on the compressor shaft must not be greater than one meter, while the center distance between the pullies is 1.75m. The belt speed should not exceed 1600m/min. Determine the number of V-belts required to transmit the power, if each belt has a cross sectional area if each belt has a cross sectional area of $375mm^2$, density $1000kg/m^3$ and allowable tensile stress of 2.5Mpa. The groove angle of the pullies is 35°. The coefficient of the friction between the belt and the pulley is 0.25. Calculate also the length required for each belt.	*CO5*	*PO2*	**12**
		b)	A belt drive consists of 2 V-belts in parallel, on grooved pullies of the same size. The angle of the groove is 30°. The cross-sectional area of each belt $750mm^2$ and $\mu=0.12$. The density of the belt material is 1200 kg/m^3 and the maximum safe stress of the material is 7Mpa. Calculate the power that can be transmitted between the pullies of 300mm diameter rotating at 1500rpm.Find also the shaft speed in rpm, at which the power transmitted would be a maximum.	*CO5*	*PO3*	**08**
			OR			
	10	a)	Explain the design concepts of V-belts, Ropes and Chains with respect to design of flexible elements.	*CO5*	*PO1*	**10**
		b)	A rope drive is to transmit 250kW from a pulley of 1.2m diameter running at a speed of 300rpm. The angle of lap maybe taken as π radians. The groove half angle is 22.5°. The ropes to be used are 50mm in diameter. The mass of the rope is 1.3kg/m length and each rope has a maximum pull of 2.2 kN. The coefficient of rope and pulley is 0.3. Determine the number of ropes required. If the overhang of the pulley is 0.5 m. Suggest suitable size for the pulley shaft if it is made of steel with a shear stress of 40Mpa.	*CO5*	*PO2*	**10**

****