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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering & Management **Duration: 3 hrs.**
Course Code: 23IM4ESDME / 22IM4PCMCD **Max Marks: 100**
Course: Design of Machine Elements / Machine Design

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. 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)		What is stress concentration explain any one method of reducing the same	*CO1*	*PO1*	**05**
	b)		A shaft of 50 mm diameter is step down to 40 mm with a fillet radius of 5 mm. If the allowable shear stress is 50 MPa, determine the power that can be transmitted at 1200 rpm.	*CO3*	*PO1* *PO3* *PO4*	**05**
	c)		A plate of C45 steel ($\sigma_{y=}$ 353 MPa) is subjected to the following stresses σ_x = 150 MPA, $\sigma_{y=}$ 100 MPa and τ_{XY} = 50 MPa. Find the factors safety by i) Maximum principal stress theory ii) Maximum shear test theory iii) Hencky Mises theory	*CO3*	*PO1* *PO3* *PO4*	**10**
			OR			
2	a)		Explain clearly the causes and remedies for stress concentration with neat sketches.	*CO2*	*PO2*	**08**
	b)		Steel rod (SAE 9260 oil quenched is subjected to tensile load which varies from 120 kN to 40 kN. Design the safe diameter of the rod using Soderberg criteria. Adopt factor safety as 2, stress concentration factor as unity and correction factor for load , size and surface as 0.75 0.85 and 0.91respectivelly.	*CO2*	*PO1* *PO3* *PO4*	**12**
			UNIT - II			
3	a)		Design a knuckle joint to connect two mild steel rods to sustain an axial pull of 150kN. The pin is of same material. Assume the working stresses in the material are 80MPa, 40MPa and 120MPa.	*CO2*	*PO1* *PO3* *PO4*	**10**
	b)		Design a socket and spigot type cotter joint to connect two mild steel rods for a pull of 100 kN. The material selected for the joint has the following design stress, σ_t = 100 MPa σ_c = 150 MPa and $\tau_{=}$ 60 MPa.	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**10**
			OR			

	4	a)	Design a socket and spigot type cotter joint to connect Two mild steel rods for a pull of 30 kN. Maximum permissible design stresses are, σ_t = 55 MPa σ_c = 70 MPa and τ = 40 MPa.	*CO3*	*PO1 PO3 PO4*	**10**
		b)	Design a sleeve coupling to transmit 10 kilowatt at 200 rpm. The allowable values of shear and compressive stresses for the shaft and key material may be taken have 60 MPa and 130 Mpa. The allowable shear stress in cast iron sleeve is equal to 15 MPa.	*CO3 CO4*	*PO1 PO3 PO4 PO12*	**10**
			UNIT - III			
	5		Design a pair of spur gears to transmit power of 18 kW from a shaft running at 1200 rpm to a parallel shaft to be run at 450 rpm maintaining a distance of 160 mm between the shaft centers. Suggest suitable hardness for the pair of gears.	*CO2*	*PO2 PO3 PO4*	**20**
			OR			
	6	a)	Derive an expression for beam strength of a spur gear tooth using standard notation.	*CO3 CO4*	*PO1 PO12*	**06**
		b)	A pair of carefully cut (class II) Spur gear with Pinion diameter 120 mm transmits 20 kW at 230 rpm of the gear. Reduction ratio is 5:1. The pinion is made of cast steel heat treated with allowable stress 197 MN/m^2 . Gear is made of cast iron with stress 36 MN/m^2 . Determine module, face width and number of teeth on the pinion and the gear. Take pressure angle as 20 degree full depth involute.			**14**
			UNIT - IV			
	7		A shaft is supported by two bearings placed 1100 mm apart. A pully of diameter 620 mm he is keyed at 400 mm to the right from the left hand bearing and this drive a pully directly below it with a maximum tension of 2.75 kN. Another pully of diameter 400 mm is placed 200 mm to the left of right hand bearing and is driven with a motor placed horizontally to the right hand bearing and is driven with a motor placed horizontally to the right. The angle of contact of the pulley is 180^o and coefficient of friction is 0.3. Find the diameter of the shaft. Assume Kb = 3.0 Kt = 2.5 σ_u = 300 MPa, σ_y = 190 MPa.	*CO3 CO4*	*PO1 PO3 PO4 PO12*	**20**
			OR			
	8	a)	A mild steel shaft transmits 29 kW at 200 rpm. It carries a central load of 2000 Newton and is simply supported between the bearings 1.5 m apart. Determine the commercial size of the shaft, if the shear stress for the material is 60 MPa.	*CO3 CO4*	*PO1 PO3 PO4 PO12*	**10**
		b)	A solid shaft is subjected to a maximum torque of 1000 N- m and a maximum bending moment of 150 N- m. The shaft is subjected to minor sharks and made up of commercial Steel for which the yield stress is 300 MPa. Determine the size of the shaft required, assuming the a factor safety of 2.5.	*CO3 CO4*	*PO1 PO3 PO4 PO12*	**10**
			UNIT - V			
	9		SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75 mm and length 75 mm, oil enters at 40 degree Celsius. The journal rotates at 1200 rpm. The diameter	*CO3 CO4*	*PO1 PO3 PO4*	**20**

			clearance is 75 micro metre. Assume operating temperature of the oil as 53 degree Celsius, determine i) Magnitude and location of the minimum oil film thickness ii) Power loss iii) Oil flow through the bearing iv) side leakage		*PO12*	
			OR			
	10	a)	Derive Petroff's equation using suitable notation. State the assumptions made	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**06**
		b)	Design the main bearing for a stationary slow speed steam engine for the following data. Journal diameter = 200 mm , Maximum load on the piston 80 kN, Engine speed is 200 rpm.	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**14**

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