U.S.N.										

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

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering & Management **Duration: 3 hrs.**
Course Code: 22IM4PCMCD **Max Marks: 100**
Course: 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.

			UNIT - I	CO	PO	Marks
1	a)		Define factory of safety. Discuss factors influencing selection of appropriate value for the factor of safety.	CO1	PO1	**05**
	b)		A shaft of 50 mm diameter is stepped 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.	CO2	PO2	**05**
	c)		A plate of C45 steel (σ_y = 353 MPa) is subjected to the following stresses. σ_x = 150 MPa, σ_y = 100 MPa and τ_{xy} = 50 MPa. Find the factor of safety by i) Maximum principal stress theory ii) Maximum shear stress theory iii) Hencky Mises theory	CO3	PO1 PO3 PO4	**10**
			OR			
2	a)		Derive Soderberg criterion for reversed bending load.	CO1	PO1	**10**
	b)		Define stress concentration. What are the methods to reduce stress concentration?	CO1	PO1	**10**
			UNIT - II			
3	a)		Design the assembly of a knuckle joint to connect two mild steel rods subjected to an axial pull of 100kN. The allowable stresses for rods and pins are 100 MPa, 130 MPa, and 60 MPa in tension, crushing and shear respectively.	CO3	PO1 PO3 PO4	**10**
	b)		Design a sleeve coupling to transmit 10 kW at 200 rpm. The allowable values of shear stress and compressive stress for the shaft and key material may be taken as 60 MPa & 130 MPa. The allowable shear stress in cast iron sleeve is equal to 15 MPa.	CO3 CO4	PO1 PO3 PO4 PO12	**10**
			OR			

	4	a)	Design a socket and spigot type cotter joint to sustain an axial load of 80,000N. The material selected for the joint is C-40 steel. Take a factor of safety of 1.75	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**10**
		b)	Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used: Shear stress for shaft, bolt and key material = 40 MPa Crushing stress for bolt and key = 80 MPa Shear stress for cast iron = 8 MPa	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**10**
			UNIT - III			
	5	a)	Derive an expression for beam strength of a spur gear tooth using standard notation. State the assumptions under which the equation is valid.	*CO2*	*PO2*	**08**
		b)	A pair of mating spur gears have 20º FDI teeth of 8 mm module. The number of teeth on pinion is 20 and 5kW will be transmitted at 1500 rpm. The transmission ratio(i) is 5:2. Calculate i) No of teeth required for gear ii) Pitch circle diameters d_1& d_2 iii) Torque on each shaft iv) Normal force v) Tangential force and vi) Radial force	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**12**
			OR			
	6		Design a pair of spur gears to transmit 18KW 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 center lines of the shaft.	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**20**
			UNIT - IV			
	7	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* *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 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* *CO4*	*PO1* *PO3* *PO4* *PO12*	**10**
			OR			
	8		A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**20**

			and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.			
			UNIT - V			
	9	a)	Derive Petroff's equation using suitable notations. State the assumptions made.	*CO2*	*PO2*	**08**
		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 =200 rpm	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**12**
			OR			
	10		SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75mm and length 75mm, oil enters at 40^0C. The journal rotates at 1200rpm. The diametral clearance is 75µm. Assume operating temperature of the oil as 53^0C and determine a) Magnitude and location of the minimum oil film thickness b) Power loss c) Oil flow through the bearing d) Side leakage	*CO3* *CO4*	*PO1* *PO3* *PO4* *PO12*	**20**