U.S.N.										

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

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 22IM4PCMCD **Max Marks: 100**
Course: MACHINE DESIGN **Date: 22.09.2023**

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)	State and explain the theories of failure.	*CO1*	*PO1*	**06**
	b)	A round rod of diameter 30mm is to sustain an axial compressive load of 20kN and twisting moment of 1.5kNm. the rod is made of C40 steel with σ_y = 328.6MPa. Determine the factor of safety using all theories of failure.	*CO3*	*1,3,4*	**14**
		OR			
2	a)	Derive Soderberg's design equation for members subjected to variable stresses.	*CO1*	*PO1*	**06**
	b)	A round rod of diameter 1.2d is reduced to d with a fillet radius 0.1d. This stepped rod is to sustain a twisting moment that fluctuates between 2.5kNm and 1.5kNm together with a bending moment that fluctuates between 1kNm and -1kNm. The rod is made of steel stress σ_y = 328.6MPa, σ_u = 620MPa. Determine the value of 'd'	*CO2*	*PO2*	**14**
		UNIT – II			
3	a)	A bush pin type flexible coupling has four pins of size M16, made of steel and has allowable shear stress of 60MPa. The outside diameter and length of rubber bush on the pin are 38mm and 45mm respectively. The pins are located on a pitch circle of diameter 200mm. The allowable bearing pressure in the rubber bush is 1 MPa. If the coupling rotates at 900rpm, calculate the power that can be transmitted and check whether the size of pin is acceptable.	*CO3*	*PO1* *PO3* *PO4*	**10**
	b)	Design a knuckle joint to connect two circular rods which is subjected to an axial tensile stress of 50kN. The rods are coaxial and a small amount of angular movement between their axes is permissible. The design stresses may be taken as 80MPa, 40MPa and 80MPa in tension shear and compression respectively.	*CO3*	*PO1* *PO3* *PO4*	**10**

			UNIT – III			
	4	a)	Define gear. Briefly explain its classification with suitable examples.	*CO1*	*PO1*	**08**
		b)	A forged steel untreated SAE 1040 rotating at 400rpm drives a high-grade cast-iron ASTM 50. The transmission ratio is 4:1. The power required to transmit is 7kW. With suitable assumptions design the gear and obtain the hardness number.	*CO3*	*PO1* *PO3* *PO4*	**12**
			UNIT – IV			
	5	a)	With usual notations and suitable assumptions prove that a hollow shaft is stronger than solid shaft.	*CO1*	*PO1*	**08**
		b)	In an axial flow rotary compressor, the shaft is subjected to a maximum torque of 1500Nm and a maximum bending moment of 3000Nm. Determine the diameter of the compressor shaft neglecting the axial load. The shear stress in the shaft material is 50MPa. If hollow shaft is considered taking the inner diameter to outer diameter ratio as 0.6, determine the percentage of material saved in hollow shaft.	*CO3*	*PO1* *PO3* *PO4*	**12**
			UNIT – V			
	6	a)	Briefly explain the properties of lubrication.	*CO1*	*PO1*	**05**
		b)	Define bearing. Classify the bearings based on rolling and sliding.	*CO1*	*PO1*	**05**
		c)	Determine the power loss for a Petroff bearing of 100mm in diameter and 150mm long. The radial clearance is 0.05mm. speed of the journal is 1000pm. The lubricating oil is SAE 10 and bearing operating temperature is 60°C.	*CO3*	*PO1* *PO3* *PO4*	**10**
			OR			
	7	a)	With suitable assumptions and notations derive Petroff's equation to determine the coefficient of friction.	*CO1*	*PO1*	**10**
		b)	A full journal bearing of 50mm diameter, 75mm long supports a radial load of 1000N. The speed of the shaft is 600rpm. The surface temperature of bearing is limited to 60°C and the room temperature is 30°C. Determine the viscosity of the oil if the bearing is well ventilated and no artificial cooling is to be used. Assume the ratio of journal diameter to diameter clearance is 1000.	*CO4*	*PO1,* *PO3,* *PO4,* *PO12*	**10**

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