Reg. No.												

Question Paper Code	11580

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022

Fifth Semester

Mechanical Engineering

20MEPC504 - DESIGN OF MACHINE ELEMENTS

(Regulations 2020)

(Use of approved design data books permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	State the factors influencing the design of machine components.	*2,K1,CO1*
2.	Differentiate between repeated stress and reversed stress.	*2,K2,CO1*
3.	List out the applications of woodruff keys.	*2,K1,CO3*
4.	Distinguish between shaft and spindle.	*2,K1,CO3*
5.	What is a gib? Why it is provided in a cotter joint?	*2,K1,CO4*
6.	What is meant by throat thickness in a fillet weld?	*2,K1,CO4*
7.	Define the term coefficient of steadiness.	*2,K1,CO5*
8.	Mention the different types of stresses induced in the wires of helical compression and torsional springs.	*2,K1,CO5*
9.	Distinguish between the L_{10} and L_{50} life of bearing.	*2,K1,CO6*
10.	List any four advantages to rolling contact bearings over sliding contact bearings.	*2,K1,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	A rotating shaft of 8 mm diameter is made of plain carbon steel (σ_y= 200 N/mm^2). It is subjected to an axial tensile load of 2.5 kN, a steady torque of 25 N-m and a maximum bending moment of 37.5 N-m. Calculate the factor of safety.	*13,K3,CO1*
		OR	
	b)	A Figure shows a C-clamp, which carries a load P of 25 kN. The cross-section of the clamp is rectangular and the ratio of width to thickness (b/t) is 2: 1. The clamp is made of cast steel of Grade 20-40 (S_{ut}= 400 N/mm^2) and the factor of safety is 4. Determine the dimensions of the cross-section of the clamp.	*13,K3,CO1*

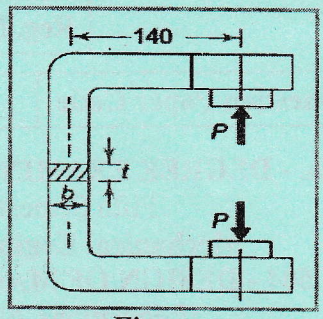


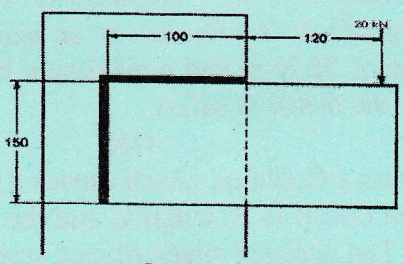
Figure.

12. a) Design and draw a cast iron flange coupling for a mild steel shaft transmitting120 kW at 450 r.p.m. The allowable shear stress in the shaft is 60 MPa. The allowable shear stress in the coupling bolts is 45 MPa. *13,K3,CO3*

OR

b) A solid shaft is supported on two bearings 1.8 m apart and rotates at 250 r.p.m. Three pulleys P, Q, and R are located on the shaft at distances of 0.6 m, 1.35 m, and 1.65 m respectively to the right of the left-hand bearing. The diameters of the pulleys P and Q are 0.75 m and 0.6 m respectively. 29.5 kW of power is supplied to the pulley R out of which 18.5 kW is taken off by pulley Q and the remaining goes to the other. The drive from P is vertically downward while from Q is downward at an angle of 60° to the horizontal. For pulleys P and Q, the tension ratio is 2, and the angle of the lap is 100°. The magnitude of load at R is 8 kN and is downward at an angle of 20° to the vertical. The shaft is required to work with a minor shock load. Design the shaft made up of C45 steel. *13,K3,CO3*

13. a) A welded connection, as shown in Figure is subjected to an eccentric force of20 kN in the plane of the welds. Determine the size of the welds, if the permissible shear stress for the weld is 120 N/mm^2. Assume static conditions. *13,K2,CO4*



OR

b) Design a knuckle joint to transmit 300 kN. The design stresses may be taken as150 MPa in tension, 120 MPa in shear, and 300 MPa in compression. *13,K3,CO4*

14. a) Design a connecting rod for an IC engine from the following data. Piston diameter = 125 mm; Stroke = 150 mm; Length of the connecting rod = 300 mm; Maximum gas pressure at 5% of the stroke = 5 MPa; Mass of reciprocating parts = 2kg; Factor of safety = 5; Material = Steel of 35 NiCr 60. *13,K3,CO5*

OR

b) A punch press pierces 35 holes per minute in a plate using 10 kN-m of energy per hole during each revolution. Each piercing takes 40 percent of the time needed to make one revolution. The punch receives power through a gear reduction unit which in turn is fed by a motor-driven belt pulley 800 mm in diameter and turning at 210 r.p.m. Find the power of the electric motor if the overall efficiency of the transmission unit is 80 percent. Design a cast iron flywheel to be used with the punching machine for a coefficient of steadiness of 5 if the space consideration limits the maximum diameter to 1.3 m. *13,K2,CO5*
Allowable shear stress in the shaft materials = 50 MPa
Allowable tensile stress for cast iron = 4 MPa
Density of cat iron = 7200 kg/m^3.

15. a) Select a suitable deep grove ball bearing for a drilling machine spindle rotating at about 2000 rpm. It is subjected to an axial load of 1.5 kN and a radial load of 3 kN. It has to work for 50 hours per week for two years. Take the diameter of the spindle as 45 mm. Assume uniform and steady load. *13,K3,CO6*

OR

b) The following data are given for a 360° hydrodynamic bearing: Journal diameter =100 mm, radial clearance=0.12 mm, Radial load=50 kN, bearing length=100mm, Journal speed= 1440 r.p.m. and Viscosity of the lubricant = 16 CP. Calculate (a) Minimum film thickness, (b) Coefficient of friction, and (c) Power lost in friction. *13,K3,CO6*

PART - C (1 × 15 = 15 Marks)

16. a) A rotating shaft of 16 mm diameter is made of plain carbon steel with a yield stress of 400 N/mm^2. It is subjected to an axial load of 4500 N, a steady torque of 50 Nm and maximum bending moment of 75 Nm. Calculate the factor of safety based on (i) Maximum Principal stress theory (ii) Maximum shear stress theory and (iii) Maximum strain energy theory (**ν = 0.3**). *15,K3,CO2*

OR

b) A machine component is subjected to a fluctuating stress of +300 MN/m^2 and -150 MN/m^2. Determine the minimum value of ultimate strength according to (i) Goodman relation (ii) Gerber relation and (iii) Soderberg relation. Take Yield strength = 0.55 Ultimate strength, Endurance strength = 0.5 ultimate strength and Factor of safety = 2. *15,K3,CO2*