Reg. No.															

Question Paper Code	12885

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Fifth Semester

Mechanical Engineering

20MEPC504 - DESIGN OF MACHINE ELEMENTS

Regulations - 2020

(Use of PSG Design Data Book is permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	What are the various phases of design process?	2	K1	CO1
2.	Differentiate Hardness and Toughness.	2	K2	CO1
3.	Define critical speed of shaft.	2	K1	CO3
4.	List out the various types of keys.	2	K1	CO3
5.	List the various modes of failure of fork end in knuckle joint.	2	K1	CO4
6.	Why are welded joints preferred over riveted joints?	2	K1	CO4
7.	What is Nipping in a leaf spring?	2	K1	CO5
8.	How does the function of flywheel differ from that of governor?	2	K1	CO5
9.	Give an example for anti-friction bearing.	2	K1	CO6
10.	What is the advantage of Teflon which is used for bearings?	2	K1	CO6

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	A Shaft is loaded as shown in Figure-1. Determine the stresses at point A & B.	13	K3	CO1

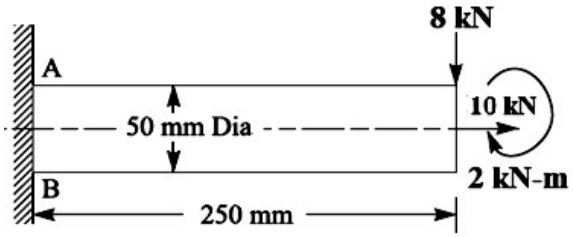

Figure-1

OR

	b)	A Wall bracket as shown in Figure-2 is subjected to a pull of 4 kN at 60° to the vertical. The cross-section of the bracket is rectangular having "b = 4t". Determine the dimension if the maximum permissible stress induced in the bracket is limited to 30MPa.	13	K3	CO1

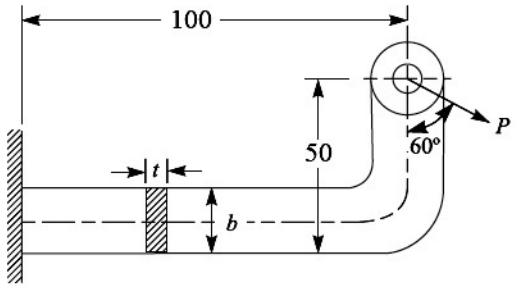

Figure-2

12. a) A steel solid shaft transmitting 15kw at 200rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5mm module is located 100mm to left of the right hand bearing and delivers power horizontally to right. The gear having 100 teeth of 5mm module is located 150mm to right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54MPa in shear, Determine the diameter of the shaft. *13 K3 CO3*

OR

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. *13 K3 CO3*

13. a) Design a cotter joint to connect a piston rod to the cross head. The maximum steam pressure on the piston rod is 35kN. Assuming that all parts are made of the same material having, σ_t = 50 MPa; τ = 60 MPa; σ_C = 90 MPa; Draw a neat sketch of the joint designed. *13 K3 CO4*

OR

b) A Figure-3 shows a welded joint subjected to an eccentric load of 20 kN. Determine the uniform size of the weld on the entire length of two legs. Take permissible shear stress for the weld material as 80 MPa. *13 K3 CO4*

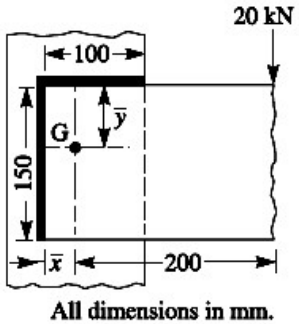

Figure- 3

14. a) A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 250 N to 750 N. The spring index is 6 and the design factor of safety is 2. If the yield stress in shear is 700 MPa and endurance stress in shear is 300 MPa, Design the spring. The compression of the spring at the maximum load is 20 mm. The modulus of rigidity for the spring material may be taken as 80 kN/mm^2. *13 K3 CO5*

OR

b) The connecting rod of a petrol engine is to be designed for the following data: *13 K3 CO5*
Piston Diameter = 80mm; Stroke = 120 mm; Mass of reciprocating parts = 1.5 kg; Length of connecting rod = 240 mm; Maximum speed = 2800 rpm; Factor of safety = 6; Explosion pressure corresponding to 10° of crank angle is 3 MPa; Material 40Cr1 steel.

15. a) A Journal Bearing is to be designed for a centrifugal pump for the following data: *13 K3 CO6*
Load on the Journal = 12 kN; Diameter of the Journal = 75mm; Speed = 1440 rpm; Atmospheric temperature of the oil = 16°C; Operating temperature of the oil = 60°C; Absolute viscosity of oil at 60°C = 0.023 kg/m-s.

OR

b) A Single row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust for of 3 kN. The shaft rotates at 1200 rpm. The expected life of the bearing is 20000 hours. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable bearing. *13 K3 CO6*

PART - C (1 × 15 = 15 Marks)

16. a) 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*

OR

b) A bolt is subjected to an axial pull of 10kN and a transverse shear force of 5kN. The yield strength of the bolt is 300MPa. Considering a factor of safety of 2.5. Determine the diameter of the bolt, using (i) Maximum normal stress theory, (ii) Maximum shear stress theory, and (iii) Maximum principal strain theory (iv) The distortion energy theory. Take poisson's ratio as 0.25. *15 K3 CO2*