Reg. No.																

Question Paper Code	14770

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

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 (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	The material commonly used for machine tool bodies is a) mild steel b) aluminium c) brass d) cast iron	1	K1	CO1
2.	The ratio of the ultimate stress to the design stress is known as a) elastic limit b) strain c) factor of safety d) bulk modulus	1	K1	CO1
3.	The bending stress in a curved beam is, a) Zero at the neutral axis b) Zero at the centroid axis c) Zero at the inner fiber d) Zero at the outer fiber	1	K2	CO1
4.	Surface endurance limit of gear material is dependent upon its a) Elastic strength b) Yield strength c) Brinell hardness number d) Toughness	1	K2	CO2
5.	Stress concentration in static loading is more serious in a) ductile materials b) brittle materials c) equally serious in both cases d) depends on other factors	1	K1	CO2
6.	Which type of failures does modified good man line combines? a) Fatigue and yield a) Bending and fatigue c) Yield and bending c) Fatigue, bending and yield	1	K2	CO2
7.	Flexible shafts have _____ rigidity in bending moment. a) High b) Low c) Very high d) Extremely low	1	K1	CO3
8.	In machine design, which of the following joins two rotating shafts to each other? a) Key b) Coupling c) Gear d) Belt drive	1	K1	CO3
9.	A key made from a cylindrical disc having segmental cross-section, is known as _____key. a) feather b) gib head c) woodruff d) flat saddle	1	K1	CO3
10.	A rivet is specified by_____. a) Shank diameter b) Length of tail c) Type of head d) Length of rivet	1	K1	CO4

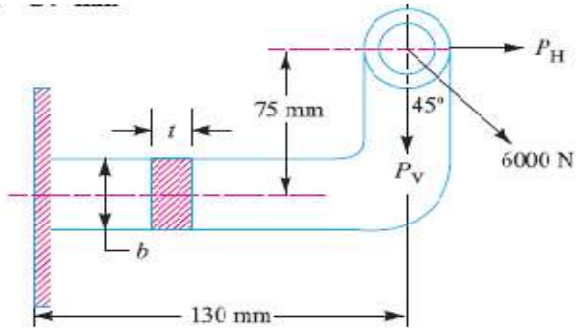
11.	The parallel fillet welded joint is designed for a) tensile strength b) compressive strength c) bending strength d) shear strength	*1*	*K2*	*CO4*
12.	A cotter joint is used to transmit a) axial tensile load only b) axial compressive load only c) combined axial and twisting loads d) axial tensile or compressive loads	*1*	*K1*	*CO4*
13.	The cross-section of the flywheel arms is usually _____ cross section. a) elliptical b) rectangular c) I d) L	*1*	*K2*	*CO5*
14.	The connecting rod of an engine is subjected mainly to_____ a) Torsion b) Shear c) Axial tension and compression d) Pure bending	*1*	*K1*	*CO5*
15.	Which of the following is an anti-friction bearing? a) Ball bearing b) Thrust bearing c) Sleeve bearing d) Journal bearing	*1*	*K2*	*CO6*
16.	The rolling contact bearings are known as a) thick lubricated bearings b) plastic bearings c) thin lubricated bearings d) antifriction bearings	*1*	*K1*	*CO6*

PART – A (ii) (Short Answer Questions)
(6 × 3 = 18 Marks)
Answer ALL Questions

17.	Infer fits and tolerances. How are they designated?	*3*	*K2*	*CO1*
18.	Distinguish between alternating stress and fluctuating stress.	*3*	*K2*	*CO2*
19.	Make use of types of keys used in machine design and mention one application for each.	*3*	*K3*	*CO3*
20.	Select the rivet heads according to Indian standard specifications.	*3*	*K3*	*CO4*
21.	Identify the various types of stresses induced in a flywheel rim.	*3*	*K3*	*CO5*
22.	Compare the sliding contact and the rolling contact bearings.	*3*	*K2*	*CO6*

PART - B (Descriptive Answer Questions)
(6 × 11 = 66 Marks)
Answer ALL Questions

23.	a)	Illustrate the phases of design process and the factors influencing the machine design.	*11*	*K3*	*CO1*
		OR			
	b)	A mild steel bracket as shown in fig. is subjected to a pull of 6000 N acting at 45° to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross-sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60 MPa.	*11*	*K3*	*CO1*



24. a) The load on a bolt consists of an axial pull of 10kN together with a transverse shear force of 5KN. Find the diameter of bolt required according to. *11 K3 CO2*
1. Maximum principal stress theory
2. Maximum shear stress theory
3. Maximum principal strain theory
Take permissible tensile stress at elastic limit 100 MPa and poission's ratio 0.3.

OR

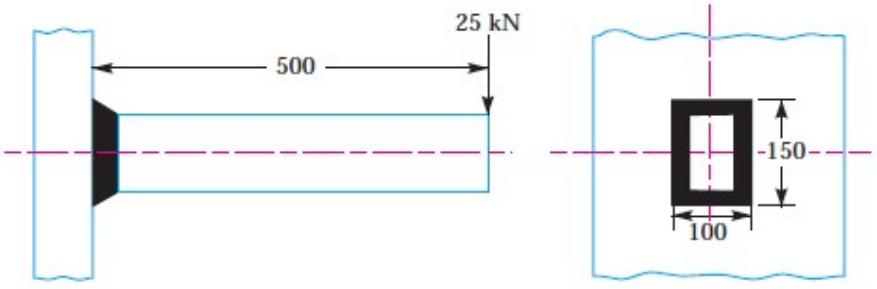
b) A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm^2. The corrected endurance limit stress for the machine component is 270 N/mm^2. The ultimate tensile strength and yield strength of material are 600 N/mm^2 and 450 N/mm^2 respectively. Find the factor of safety using: (i) Gerber theory (ii) Soderberg line (iii) Goodman line and (iv) Also, find factor of safety against static failure. *11 K3 CO2*

25. a) A hollow steel shaft transmits 600 kW at 500 rpm. The maximum shear stress is 62.4 MPa. Find the outside and inside diameter of the shaft, if the outer diameter is twice of inside diameter, assuming that the maximum torque is 20% greater than the mean torque. *11 K3 CO3*

OR

b) Design a rigid flange coupling to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below: *11 K3 CO3*
Shear stress on shaft =100 MPa
Bearing or crushing stress on shaft =250 MPa
Shear stress on keys =100 MPa
Bearing stress on keys =250 MPa
Shearing stress on cast iron =200 MPa
Shear stress on bolts =100 MPa

26. a) A rectangular cross-section bar is welded to a support by means of fillet welds as shown in Fig. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 MPa. *11 K3 CO4*



All dimensions in mm

OR

b) Design a knuckle joint to connect two mild steel bars under a tensile load of 25 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing. *11 K3 CO4*

27. a) A helical spring is to be designed for an operating pressure load range of 90N to 135 N. The deflection of the spring for this load range is 7.5 N/mm. Assuming a spring index of 10, a permissible shear stress of 480 N/mm^2 for the material and is modulus of rigidity is 0.8 x 10^5 N/mm^2. Determine the dimensions of the spring. *11 K3 CO5*

OR

b) Design a leaf spring for the following specifications : *11 K3 CO5*
Total load = 140 KN; Number of springs supporting the load = 4; Maximum number of leaves = 10; Span of the spring = 1000 mm; Permissible deflection = 80 mm. Take Young's modulus, E = 200 kN/mm^2 and allowable stress in spring material as 600 MPa.

28. a) Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor ZN/p may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C temperature and the atmosphere temperature is 30°C. The energy dissipation coefficient is 875 W/m^2 °C. Take diametral clearance as 0.1 mm. *11 K3 CO6*

OR

b) A cylindrical roller bearing is subjected to a radial load of 5000N. The designed life of the bearing with 90% reliability is 15000hours. The application of factor is 1.5. If the shaft rotates at 1440 rpm. Calculate the required basic dynamic load rating of the bearing. *11 K3 CO6*