B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023
Fifth Semester
Mechanical Engineering
20MEPC504 - DESIGN OF MACHINE ELEMENTS
(Regulations 2020)

(Use of Approved 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 preferred numbers?	2,K1,CO1
2.	List any two factors that influence the process of machine design.	2,K1,CO1
3.	Define critical speed of shaft.	2,K1,CO3
4.	What is the difference between rigid and flexible coupling?	2,K2,CO3
5.	State the disadvantages of welded joints.	2,K1,CO4
6.	Name the possible modes of failure of riveting joint.	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,K2,CO5
9.	What is meant by square journal bearing?	2,K1,CO6
10.	Give an example for anti-friction bearing?	2,K1,CO6

PART - B (5 × 13 = 65 Marks)
Answer ALL Questions

11. a) A Shaft is loaded as shown in figure 1. Determine the stresses at point A & B.   13,K3,CO1
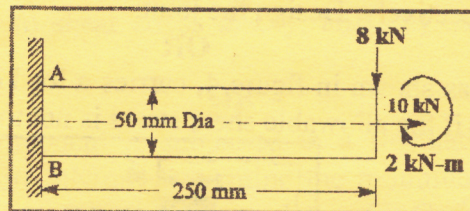

Figure 1

OR

b) A Crane hook has a trapezoidal section at A-A as shown in figure 2. Find the maximum stress at points P and Q.   13,K3,CO1
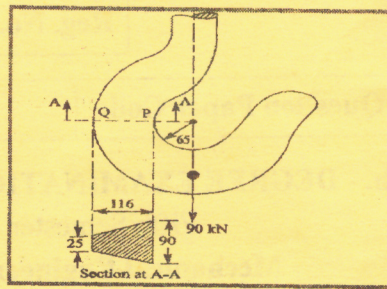
Figure 2

12. a) The shaft, as shown in figure 3, is driven by pulley B from an electric motor. Another belt drive from pulley A is running a compressor. The belt tensions for pulley A is 1500 N and 600 N. The ratio of belt tensions for pulley B is 3.5. The diameter of pulley A is 150 mm and the diameter of pulley B is 480 mm. The allowable tensile stress for the shaft material is 170 MPa and the allowable shear stress is 85 MPa. Taking torsion and bending factors as 1.25 and 1.75 respectively, find the shaft diameter.   *13,K3,CO3*
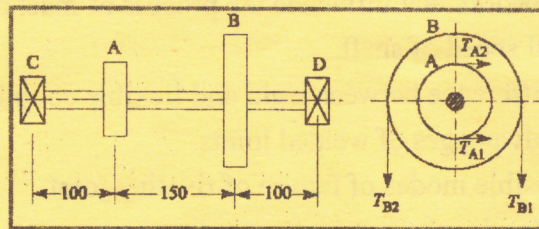

Figure 3

OR

b) Design a muff coupling to connect two shafts transmitting 40 kW at 120 rpm. The permissible shear and crushing stress for the shaft and key material are 30 N/mm^2 and 80 N/mm^2 respectively. The material for muff is CI (τ_{CI} = 15 N/mm^2). Assume the maximum torque transmitted is 25% more than the mean torque.   *13,K3,CO3*

13. a) A knuckle joint is to transmit a force of 140 kN. Allowable stresses in tension, shear and compression are 75 N/mm^2, 65 N/mm^2 and 140 N/mm^2 respectively. Design the joint.   *13,K3,CO4*

OR

b) A bracket, as shown in figure 4, carries a load of 10 kN. Find the size of the weld if the allowable shear stress is not to exceed 80 MPa.   *13,K3,CO4*
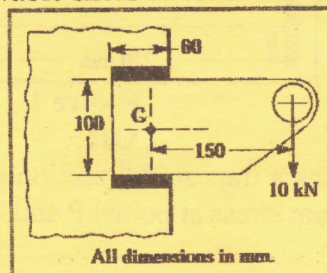

Figure 4

14. a) It is required to design a helical compression spring subjected to a   *13,K3,CO5*
force of 500 N. The deflection of the spring corresponding to this force
is 20 mm. The spring index should be 6. The spring is made of cold-
drawn steel wire with ultimate tensile strength of 1000 N/mm². The
permissible shear stress for the spring wire can be taken as 50% of the
ultimate tensile strength (G = 81370 N/mm²). Assume a gap of 1 mm
between adjacent coils under maximum load condition. The spring has
square and ground ends.

<div align="center">OR</div>

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

15. a) Design a suitable Journal Bearing for a centrifugal pump from the   *13,K3,CO6*
following data:
Load on the Bearing = 13.5kN; Diameter of the Journal = 80mm;
Speed=1440rpm; Bearing characteristic number at the working
temperature (75°C) = 30; Permissible bearing pressure intensity = 0.7
N/mm² to 1.4 N/mm²; Average atmospheric temperature = 30°C.
Increase in temperature of oil is 10°C.

<div align="center">OR</div>

b) Select a suitable deep groove ball bearing for supporting a radial load   *13,K3,CO6*
of 10 kN and an axial load of 3 kN for a life of 4000 hours at 800 rpm.
Select from 63 series. Calculate the expected life of the bearing.

<div align="center">**PART - C (1 × 15 = 15 Marks)**</div>

16. a) The force acting on a bolt consists of two components—an axial pull   *15,K3,CO2*
of 12 kN and a transverse sheer force of 6 kN. The bolt is made of steel
FeE 310 (σ_{yt} = 310 N/mm²) and the factor of safety is 2.5. Determine
the diameter of the bolt using (i) the maximum normal stress theory,
(ii) the maximum shear stress theory, and (iii) the distortion energy
theory.

<div align="center">OR</div>

b) A machine component is subjected to a fluctuating stress of +300   *15,K3,CO2*
MN/m² and -150 MN/m². 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.