Code: 23ME3503

III B.Tech - I Semester - Regular Examinations - NOVEMBER 2025

DESIGN OF MACHINE ELEMENTS
(MECHANICAL ENGINEERING)

Duration: 3 hours   Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
  2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
  3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
  4. All parts of Question paper must be answered in one place.
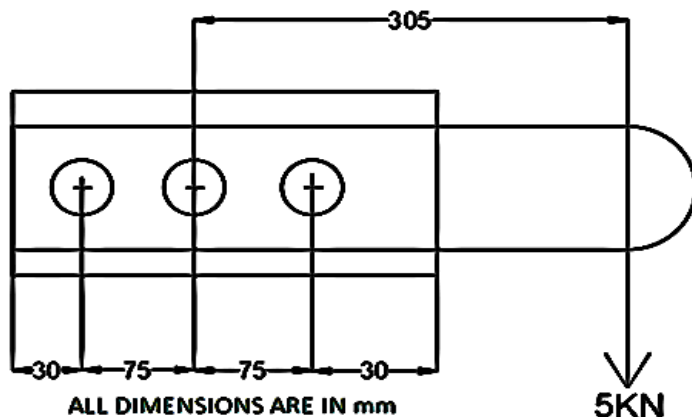
BL – Blooms Level   CO – Course Outcome

*** Design Data Book is Allowed ***

PART – A

		BL	CO
1.a)	What is factor of safety? Why is it necessary?	L2	CO1
1.b)	Differentiate endurance strength and endurance limit.	L2	CO1
1.c)	What are the advantages of welded joints?	L2	CO2
1.d)	Define Eccentric loading in bolted joints.	L1	CO2
1.e)	What is equivalent bending moment and equivalent torque?	L1	CO3
1.f)	Define Rigid couplings.	L1	CO3
1.g)	Write load deflection equation for helical spring.	L2	CO4
1.h)	State any two functions of Clutch.	L2	CO4
1.i)	State the law of gearing.	L1	CO5
1.j)	What is full journal bearing?	L1	CO5

PART – B

			BL	CO	Max. Marks
UNIT-I					
2	Discuss about the following theories of failure. (i) Maximum Principal stress theory. (ii) Maximum shear stress theory. (iii) Distortion Energy theory.		L2	CO1	10 M
OR					
3	Discuss about the basic Procedure of Machine Design.		L2	CO1	10 M
UNIT-II					
4	A steel plate is subjected to a force of 5 kN and fixed to a column by means of three identical bolts as shown in figure. The bolts are made of plain carbon steel of yield strength 380 N/mm^2 and FOS is 3. Specify the size of the bolt. ALL DIMENSIONS ARE IN mm		L3	CO2	10 M
OR					
5	a)	Sketch any three basic types of welded joints.	L2	CO2	3 M

	b)	A plate of 150 mm wide and 10 mm thick is to be welded with another plate by means of transverse welds at the ends. The plates are subjected to a load of 90 kN, find the size of the weld for static load. The permissible tensile stress should not exceed 70 MPa.	L3	CO2	7 M

UNIT-III

6		The shaft of an axial flow rotary compressor is subjected to a maximum torque of 2 kN-m and maximum bending moment of a 4 kN-m. The combined shear and fatigue factors in torsion and bending may be taken as 1.5 and 2.0 respectively. Determine the diameter of the shaft, the shear stress in shaft should not exceed 50 MN/m^2. Design a hallow shaft for the above compressor taking the ratio of inner diameter to outer diameter as 0.5. Calculate the percentage saving in material.	L3	CO3	10 M

OR

7		Design a muff coupling to connect two shafts transmitting 40 kW at 120 r.p.m. The permissible shear and crushing stress for the shaft and key material (mild steel) are 30 MPa and 80 MPa respectively. The material of muff is cast iron with permissible shear stress of 15 MPa. Assume that the maximum torque transmitted is 25 percent greater than the mean torque.	L4	CO3	10 M

		UNIT-IV			
8	a)	Write the differences between self-energizing and self-locking brakes.	L2	CO4	5 M
	b)	Discuss the factors affecting the selection of material for clutch and brake linings.	L2	CO4	5 M
		OR			
9		Design a closed coil helical spring for a boiler safety valve which is required to blow off steam at pressure of 1.5 MPa. The diameter of the valve is 50 mm. The initial compression of the spring is 40 mm and the lift is limited to 20 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is 80 kN/mm^2.	L4	CO4	10 M
		UNIT-V			
10		Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load.	L4	CO5	10 M
		OR			
11		Design a gear drive to transmit 22 kW at 1000 rpm. Speed reduction is 2.5. The center distance between the shafts is 350 mm. The materials are pinion-C45; Gear wheel CI Grade 30. Design the drive using Lewis and Buckingham equations.	L4	CO5	10 M