Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 08 -12-2025 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B. Tech. MECHANICAL ENGINEERING	
Course Code: MEC3004	**Course Name:** Design of Machine Elements-I	
Semester: V	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Marks	**14**	**14**	**20**	**16**	**20**	**16**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

(iii) Use of Data Handbook permitted.

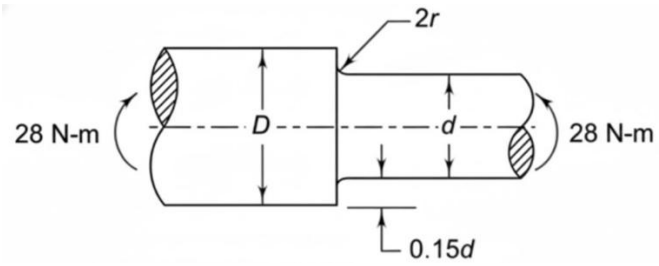
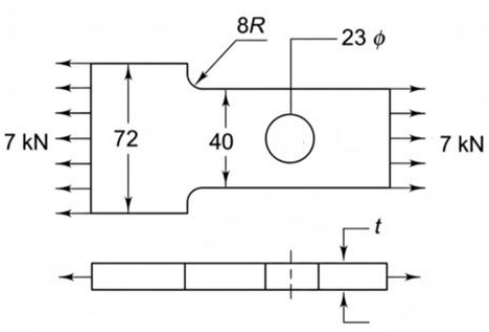
Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	What is the difference between a standard and a code?	**2 Marks**	**L1**	**CO1**
2.	What are the principal stresses?	**2 Marks**	**L1**	**CO1**
3.	What is the surface finish factor for a cylindrical component subjected to bending, having sharp circular grooves & having an ultimate tensile strength of 600 MPa?	**2 Marks**	**L1**	**CO2**
4.	Explain the phenomenon of fatigue failure mechanism.	**2 Marks**	**L1**	**CO2**
5.	Define joint efficiency in riveted joints.	**2 Marks**	**L1**	**CO4**
6.	Name the three types of failures in a riveted joint.	**2 Marks**	**L1**	**CO4**
7.	What is meant by crushing stress in riveted joints?	**2 Marks**	**L1**	**CO4**
8.	Define stress concentration.	**2 Marks**	**L1**	**CO6**
9.	Give two examples of components where stress concentration occurs.	**2 Marks**	**L1**	**CO6**
10.	What is stress concentration factor (Kt)?	**2 Marks**	**L1**	**CO6**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	A round shaft made of a brittle material and subjected to a bending moment of 28 N-m is shown in Fig. The stress concentration factor at the fillet is 1.5 and the ultimate tensile strength of the shaft material is 200 N/mm^2. Solve for the diameter d, the magnitude of stress at the fillet and the factor of safety. 	**10 Marks**	**L**3	**CO 1**
	b.	Two flat plates subjected to a tensile force P are connected by means of double-strap butt joint as shown in Fig. The force P is 250 kN and the width of the plate w is 200 mm. The rivets and plates are made of the same steel and the permissible stresses in tension, compression and shear are 70, 100 and 60 N/mm^2 respectively. Solve for (i) the diameter of the rivets. (ii) the thickness of the plates. (iii) the dimensions of the seam, viz., p, p_t, p_d, and m; and (iv) the efficiency of the joint.	**10 Marks**	**L3**	**CO 4**
		Or			
12.	**a.**	A flat plate subjected to a tensile force of 7 kN is shown in Fig. The plate material is grey cast iron FG 200 and the factor of safety is 2.5. Solve for the minimum required thickness of the plate. 	**10 Marks**	**L3**	**CO 1**
	b.	An eccentrically loaded bracket is welded to the support as shown in Fig. The permissible shear stress for the weld material is 55 N/mm^2 and the load is static. Determine the throat and leg dimensions for the welds.	**10 Marks**	**L3**	**CO 4**

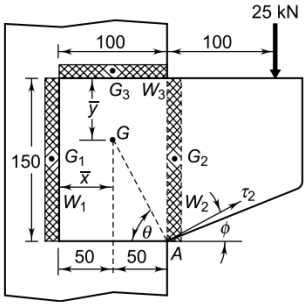
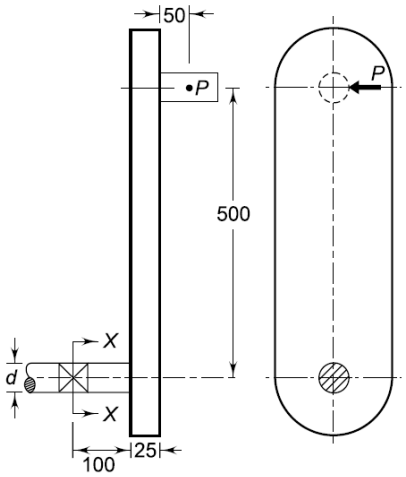
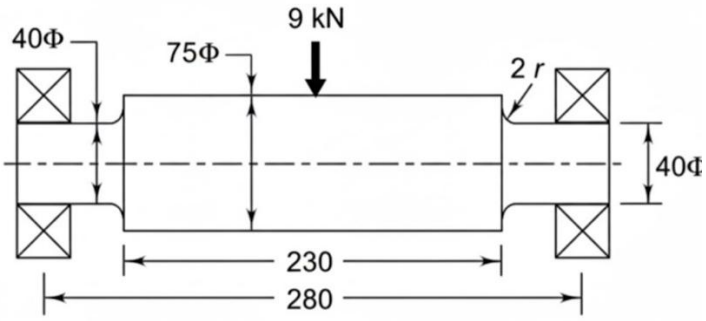
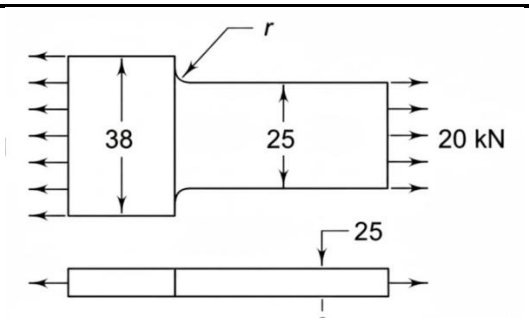


Fig. 8.28

13.	**a.**	The dimensions of an overhang crank are given in Fig. The force P acting at the crankpin is 2.5 kN. The crank is made of steel 30C8 (σyt = 420 N/mm^2) and the factor of safety is 2. Using maximum shear stress theory of failure, Estimate the diameter d at the section - XX. 	**10 Marks**	**L5**	**CO 2**
	b.	A shaft carrying a load of 9 kN midway between two bearings is shown in Fig. Assess the maximum bending stress at the fillet section. Assume the shaft material to be brittle. 	**10 Marks**	**L5**	**CO 6**
		Or			
14.	**a.**	A rotating bar made of steel 45C8 (S_ut = 720 N/mm^2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 360N/mm^2. Solve for the fatigue strength of the bar for a life of 75,000 cycles.	**10 Marks**	**L3**	**CO 2**
	b.	A plate, 25 mm thick, subjected to a tensile load of 20 kN is shown in Fig. The plate is made of cast iron (Sut = 350 N/mm^2) and the factor of safety is 2.5. Solve for the minimum fillet radius that can be kept.	**10 Marks**	**L3**	**CO 6**

15.	**a.**	A high carbon steel shaft transmits 18 kW at 400 rpm. It is supported on two bearings 1.5 m apart. The shaft receives power through a 500 mm diameter pulley mounted at 400 mm to the right of the right bearing. The power is given out through a 350 mm diameter gear mounted at 450 mm to the right of the left bearing. The belt drive is horizontal and the gear drives with a downward tangential force. Determine a suitable diameter for the shaft if the yield stress for the shaft material is 300 MPa and the factor of safety is 2.5. The load is suddenly applied with minor shock. The tension ratio of the belt is 2.5. Consider the pressure angle is 14.5 deg	**20 Marks**	**L**	**CO 3**
		Or			
16.	**a.**	A machine shaft running at 450 rpm is supported on bearings 900 mm apart. 20 kW of power is supplied to the shaft through a 500 mm pulley located at 300 mm to the right of the right bearing. The power is transmitted from the shaft through a 250 mm gear located 300 mm to the left of the left bearing. The belt drive is vertical. The pulley weights 1000 N to provide some flywheel effect. The gear is in mesh with another gear located directly above the shaft. The material of the shaft is steel 50C4 (S_{ut} = 650 and S_{yt} = 400 N/mm^2). The load is suddenly applied with minor shock. Determine the shaft diameter using the ASME code. Take the pressure angle as 22 deg.	**20 Marks**	**L**	**CO 3**

17.	**a.**	Two rods are to be connected to transmit an axial load of 140kN. The connection must allow both pulling and pushing forces. The permissible stresses for the material are: • Tensile stress = 100 MPa • Compressive stress = 150 MPa • Shear stress = 70 MPa **(a)** Identify the suitable type of joint for this application. **(b)** Justify why this joint is preferred for such loading conditions**.** **(c)** Design the joint and determine the dimensions	**20 Marks**	**L**	**CO 5**
		Or			
18.	**a.**	Two carts are to be pulled or pushed together by a joint which uses a Cotter. The total load they need to carry is 100kN. The permissible stresses are 120 MPa, 160 MPa & 80 MPa in tensile, compressive and shear respectively. Identify the type of joint, why the particular joint is used? and Design the same.	**20 Marks**	**L**	**CO 5**