PRESIDENCY UNIVERSITY

BENGALURU

Make up Examinations – December 2025

Date: 31 – 12- 2025   **Time:** 09:30am – 12:30pm

School: SOE	**Program:** B. Tech. (Mechanical Engineering)
Course Code : MEC3090	**Course Name :** Design of Machine Elements-I
Semester: MK	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	2	24	24	24	26

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 Design Data Handbook permitted.

Part A

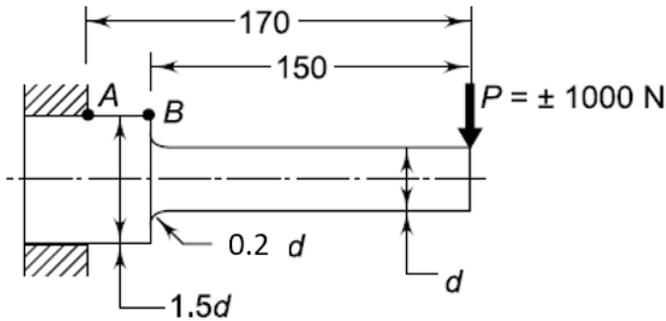**Answer ALL the Questions. Each question carries 2marks.**   **10Q x 2M=20M**

1	What is engineering design?	2 Marks	L1	CO1
2	What is the significance of surface finish in fatigue life?	2 Marks	L1	CO2
3	What is crack propagation in fatigue failure?	2 Marks	L1	CO2
4	Explain the principle of the Maximum Principal Stress Theory (MPST).	2 Marks	L1	CO3
5	Name two types of failure considered in key design.	2 Marks	L1	CO3
6	What are the common types of failures in riveted joints?	2 Marks	L1	CO4
7	Why are zigzag patterns used in riveted joints?	2 Marks	L1	CO4
8	Explain the role of the pin in a knuckle joint.	2 Marks	L1	CO5
9	Name the parts of a knuckle joint.	2 Marks	L1	CO5
10	What is a cotter joint used for?	2 Marks	L1	CO5

Part B

Answer the Questions   **Total 80 Marks.**

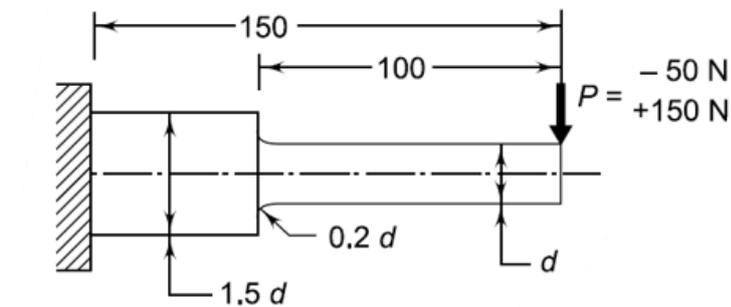| 11.	A cantilever beam made from hot rolled steel 20C8 (Sut = 540 N/mm^2) is subjected to a completely reversed load of 1000 N as shown in Fig. The notch sensitivity factor q at the fillet can be taken as 0.85 and the expected reliability is 90%. Determine the diameter d of the beam for a life of 10000 cycles. 	20 Marks	L3	CO2

or

12.	A cantilever beam made of hot rolled steel 40C8 (Sut = 600 N/mm^2 and Syt = 380 N/mm^2) is shown in Fig. The force P acting at the free end varies from -50 N to +150 N. The expected reliability is 90% and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter d of the beam at the fillet cross-section. Use Goodman's criteria. 	20 Marks	L3	CO2

13.	A mild steel shaft transmitting 25 kW at 300 rpm is supported by two bearings spaced 1.2 m apart. A 450 mm diameter pulley, located 300 mm to the right of the right bearing, supplies power to the shaft. The power is then delivered through a 300 mm diameter gear positioned 250 mm to the right of the left bearing. The belt drive is horizontal, and the gear drives using a downward tangential force. Design the shaft, considering the following: the **yield stress of the shaft material is** 234 MPa, the factor of safety is 2, and the shaft experiences sudden	20 Marks	L4	CO3

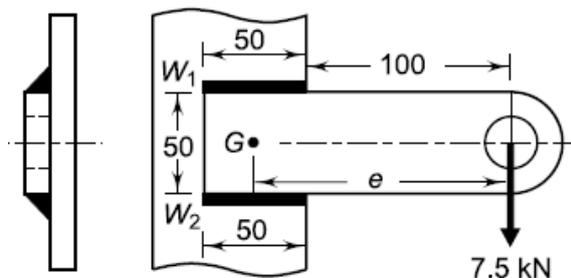|	heavy shock loads. The belt tension ratio is 3, and the gear's pressure angle is 20 degrees.			

or

14.	A machine shaft operating at 600 rpm is supported on bearings spaced 750 mm apart. The shaft receives 15 kW of power through a 450 mm diameter pulley located 250 mm to the right of the right bearing. Power is transmitted from the shaft via a 200 mm diameter gear positioned 250 mm to the left of the left bearing. The belt drive is vertical, and the pulley, weighing 800 N, provides a flywheel effect. The belt has an angle of contact of 157° and a coefficient of friction of 0.4. The gear meshes with another gear directly above the shaft. The shaft material is steel 45C8 (Sut = 600 N/mm², Syt = 380 N/mm²), and the ASME code factors for shock and fatigue are kb=2 and kt=1.5. Design the shaft using the ASME code. Assume a pressure angle of 20°.	20 Marks	L4	CO3

| 15.	A welded connection, as illustrated in the figure, is subjected to an eccentric force of 7.5 kN. Calculate the required size of the welds, given that the permissible shear stress for the weld material is 100 N/mm². Assume static loading conditions.	20 Marks	L5	CO4

Or

16.	An eccentrically loaded bracket is welded to the support as shown in Fig. The permissible shear stress for the weld material is 55 N/mm² and the load is static. Determine the throat and leg dimensions for the welds.	20 Marks	L5	CO4
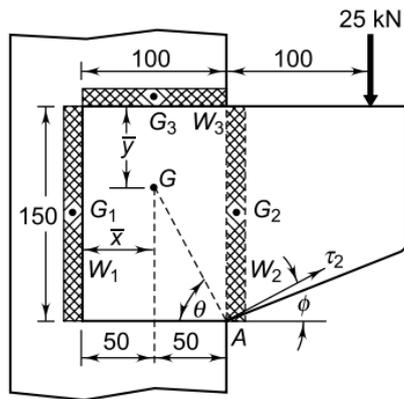
| 17. | A lifting mechanism requires a connection between two rods to transmit a load of 75 kN. The connection will be achieved using a cotter joint. The permissible stresses for the material are: tensile stress = 100 MPa, compressive stress = 150 MPa, and shear stress = 70 MPa. Identify the type of joint suitable for this application, justify its suitability, and design the joint to safely handle the given load. | 20 Marks | L5 | CO5 |

Or

| 18. | A structural linkage in a crane requires a connection to sustain axial loads of 50 kN. The joint must include a fork as a key component for assembly. The permissible stresses for the material are: tensile stress = 80 MPa, compressive stress = 80 MPa, and shear stress = 40 MPa. Identify the appropriate type of joint, justify its suitability for the application, and determine the key design parameters. | 20 Marks | L5 | CO5 |