Exam Date & Time: 11-Jan-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FIFTH SEMESTER B.TECH END SEMESTER MAKE UP EXAMINATIONS, JAN 2024
MECHANICAL DESIGN-I [MME 3153]

Marks: 50   **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1)   A bar of 50 mm diameter as shown in Fig 1a fixed at one end is subjected to a torsional
        load of 1 kN-m in addition to an axial pull of 15 kN. Determine the principal stresses if
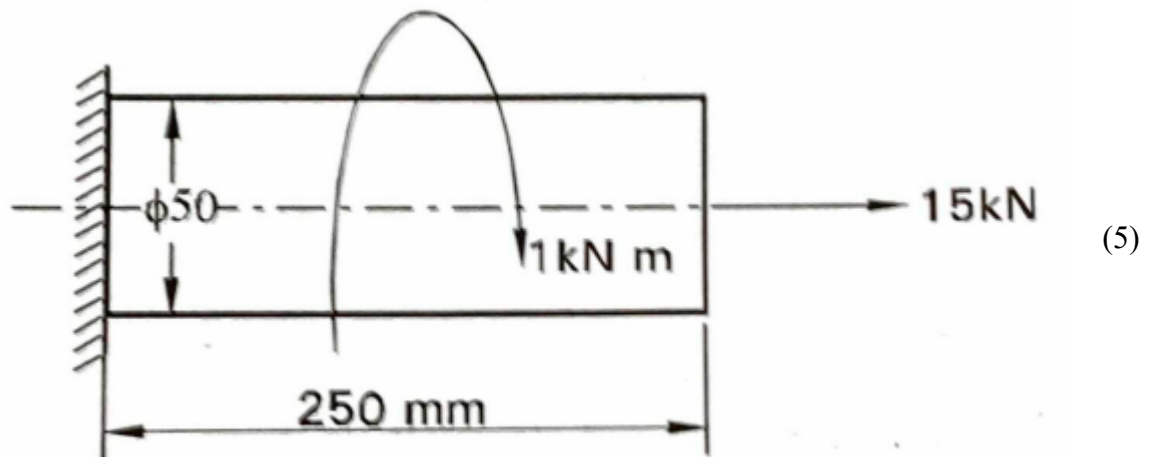   the length of the shaft is 250 mm.

A)

Fig. 1a

(5)

B)   Explain in brief (i) Maximum principal strain theory (ii) Maximum strain energy
        Theory.   (5)

2)   A cold drawn steel stepped shaft whose diameter changes from d to 1.7d with a fillet
        radius of 0.1d subjected to a torque that varies from -60000 N mm to 240000 N mm.
        Determine the size of the shaft. Take factor of safety as 1.5, Ultimate tensile strength as (5)
A)   450 MPa, Yield stress and endurance strength as 300 MPa and 225 MPa respectively.

B)   A section of a C-clamp is shown in Fig 2b. Analyse along section AB and determine the (5)
        force F that can be exerted by the screw if the maximum compressive stress in the clamp
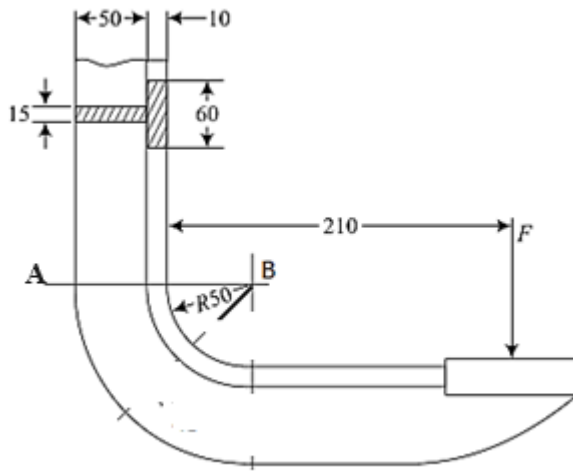   is limited to 120 MPa.

Fig 2b.

3)   A steel shaft 900 mm long between bearings receives 18 kW at 900 rpm through a 20°
      involute gear of diameter 200 mm, located at 250 mm to the left of the left bearing, and
      is driven by a gear directly placed behind it. The power is transmitted by a 400 mm
A)   diameter pulley to another pulley placed in front of it. The pulley is located at 300 mm
      to the left of the right bearing. The tension ratio is 2.7. Design a solid shaft taking   (8)
      allowable shear stress as 72 MPa. The shaft rotates in the counter clockwise direction as
      seen from the left bearing. Take Cm and Ct as 2 and 1.5 respectively.

B)   Prove that square key is equally strong in shear and compression
                                                                                                     (2)

4)   Design a double riveted joint for joining two plates of thickness 10 mm. The joint is of
      zig-zag type and the allowable tensile stress for the plate is 60 MPa, while the allowable
      stresses for shear and crushing of the rivets are 50 MPa and 80 MPa respectively.   (5)

A)

B)   A rectangular bar is welded to a support by three fillet welds as shown in Fig. 4b. For a
      steady load of 20 kN, determine the size of the weld required. Take the allowable stress
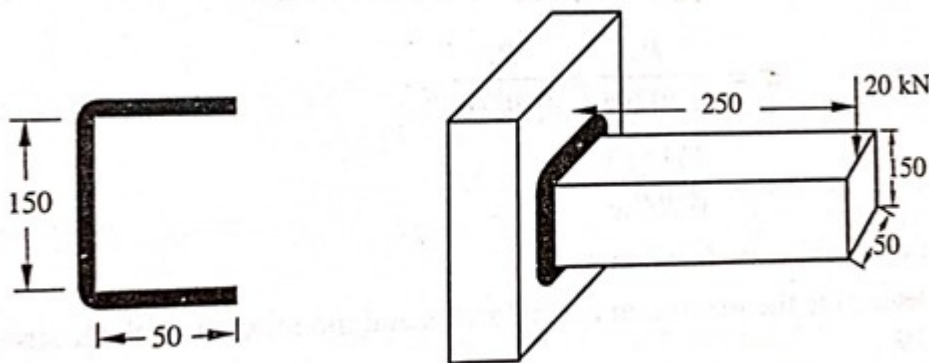   in the weld material as 94 MPa.

Fig. 4b
                                                                                                     (5)

5)   A cast iron bracket fixed to a steel structure as shown in Fig. 5a. It supports a load of   (5)
      40kN. There are two bolts at each location A and B l_1=50mm, l_2=200mm, l=400mm.

A)   Determine the size of the bolt if permissible tensile stress is 50MPa.
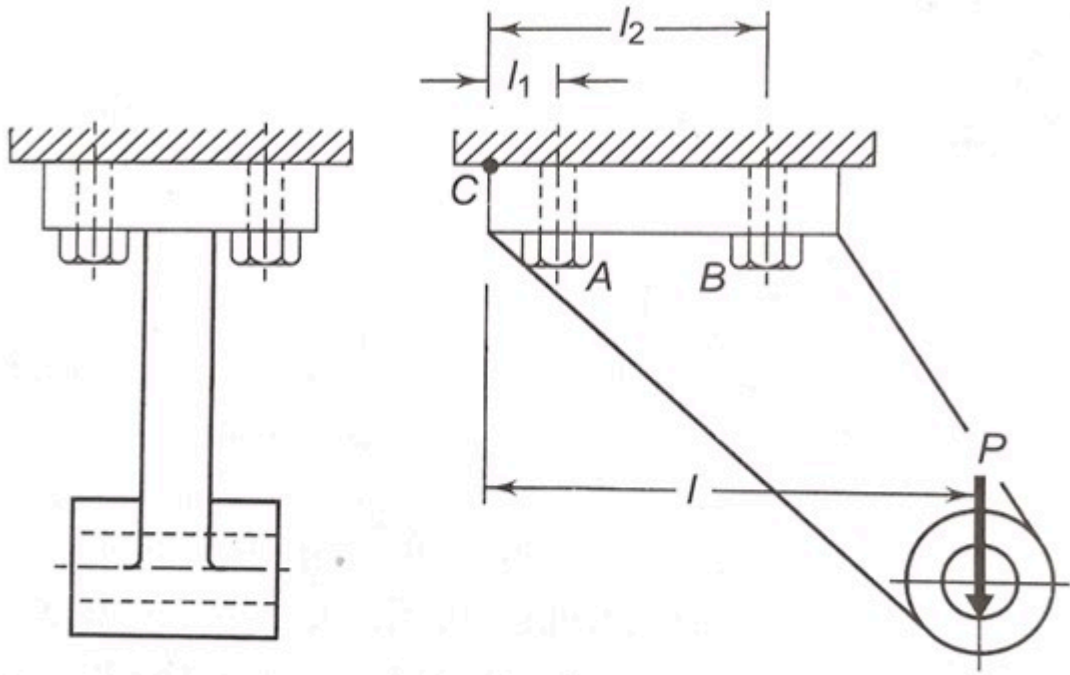

Fig. 5a

B)   The square thread of screw jack with having double start thread with nominal diameter
            of thread 80mm and 16 mm pitch is used to raise the load of 100kN. Mean collar
            diameter is 130mm. Co efficient of friction for the threads and collar are 0.1 and 0.12
            respectively.

            Determine,   (5)

            i) Torque required to raise the load

            ii) Efficiency of the screw

-----End-----