Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Regular and Supplementary Examination December 2021 (2015 scheme)

Course Code: ME401
**Course Name: DESIGN OF MACHINE ELEMENTS - I**

Max. Marks: 100   Duration: 3 Hours

(i) Use of approved design data book is permitted

(ii) Missing data if any may be suitably assumed

PART A
Answer any two full questions, each carries 15 marks.   Marks

1 a) Distinguish between codes and standards.   (3)

   b) What is the significance of preferred numbers?   (3)

   c) Determine the thickness (t) of the steel bracket loaded as shown in Fig. 1 (dimensions   (9)
       in mm) taking allowable normal stress as 90 MPa.
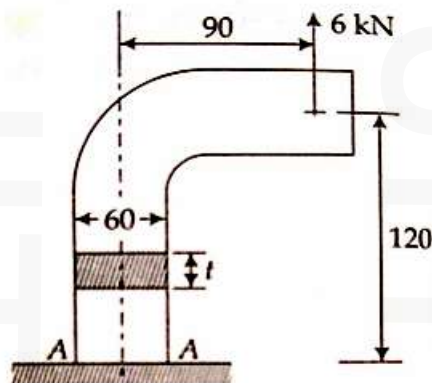
(Fig. 1)

2 a) Explain the theories of failure: i) Maximum normal stress theory and ii) Haigh's   (5)
       theory

   b) A mild steel shaft having yield stress as 230 MPa is subjected to the following   (10)
       stresses: $\sigma_x = 120$ MPa, $\sigma_y = -60$ MPa and $\tau_{xy} = 36$ MPa. Find the factor of safety
       using von Mise's theory of failure and Guest's theory of failure.

3 a) A beam of square section (70 mm x 70 mm) is simply supported over a span of 250   (5)
       mm. If a mass of 50 kg is dropped from a height of 25 mm onto the beam, determine
       the impact (shock) factor.

   b) A shaft stepped down from 60 mm to 40 mm diameter, as shown in Fig. 2, with a   (10)
       fillet radius of 8 mm rotates at 2000 rpm. Find the safe power that can be transmitted
       by this shaft limiting the shear stress to 60 MPa due to torque M_t. Take stress
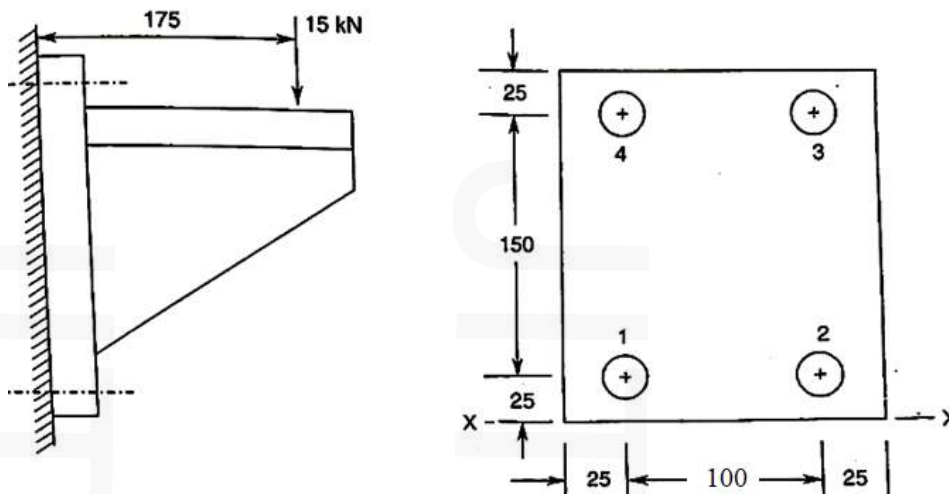
concentration into account.
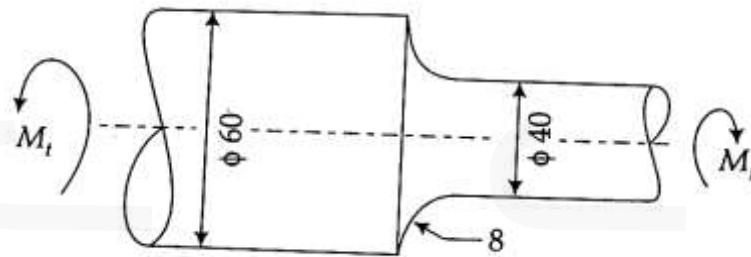
(Fig. 2)

PART B
*Answer any two full questions, each carries 15 marks.*

4   a)   What is meant by preloading/pretension in bolts?   (5)

     b)   A steel bracket as shown in Fig. 3 (dimensions in mm) is secured to a wall by means   (10)
of 4 steel bolts. The load on the bracket is 15 kN which acts at a distance of 175 mm
from the wall. Determine the size of the bolt.

(Fig. 3)

5   A bracket carrying a load of 20 kN is to be welded as shown in Fig. 4. Calculate the   (15)
size of the weld if the shear stress in the weld is not to exceed 70 N/mm^2.
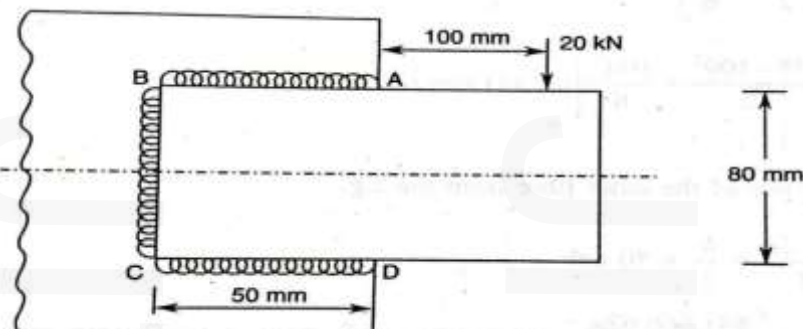
(Fig. 4)

6 a) Design and draw a knuckle joint to connect two mild steel rods to transmit a tensile force of 25 kN. The safe working stresses for tension, shear and crushing are 100 N/mm², 60 N/mm² and 160 N/mm² respectively. (10)

b) A single riveted double cover butt joint is made in 10 mm thick plates with 20 mm diameter rivets with a pitch of 60 mm. Calculate the efficiency of the joint. (5)

The allowable value of stress in shear, tension and crushing are 80 MPa, 100 MPa and 160 MPa respectively.

PART C

Answer any two full questions, each carries 20 marks.

7 a) Obtain an expression for the maximum shear stress induced in a spring wire. (5)

b) A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance strength in shear is 350 MPa, Find i) size of the spring wire ii) spring coil diameter iii) number of spring-turns and iv) free length. The compression of the spring at maximum load is 30 mm and the rigidity modulus G is 80 kN/mm². Take Wahl's curvature effect into consideration. Assume the end conditions as squared and ground. (15)

8 a) Design and draw a rigid flange coupling to transmit 18 kW at 1440 rpm. The allowable shear stress for CI flange is 4 MPa. The shafts, keys and bolts are made of annealed steel having allowable shear stress of 93 MPa. Allowable crushing stress for key is 186 MPa. Assume a key way factor of 75%. (15)

b) What are the methods to equalize the stresses in all leaves (full length and graduated) in a semi-elliptical leaf spring? (5)

9 A hollow shaft is supported by two bearings A and B placed at 1.2 m apart. A 600 mm diameter pulley B is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2 kN. Another pulley C of 400 mm diameter is placed 200 mm to the left of the left hand bearing and is driven with the help of a motor and belt which is placed at 45° to vertical and downward towards the observer. The angle of contact for both pulleys is 180° and coefficient of friction is 0.25. Determine the suitable diameter for hollow shaft having diameters ratio of 0.5. The allowable tensile and shear stresses are 63 MPa and 42 MPa respectively. Take shock factors for bending and twisting as 2.5 and 2.0 respectively. (20)

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