Q.P. Code : 600100

(4 Hours)   [Total Marks : 100

(Old Course)

Instructions: 1) Question *No. 1* is compulsory.
                 2) Answer any *four* from the remaining six questions.
                 3) Use of recommended *Design data book* is permitted.
                 4) Use your judgment for unspecified data, if any.

Q.1 Solve any *four* of the followings: (4x5 =20)
     a) What do you understand by following designations of materials:
          i) FG 300   ii) SG 800/2   iii) 30C8   FeE 350   iv) 40Ni 1Cr 60
     b) Explain any two theories of failures
     c) Why shot peening is needed for springs ?. Explain.
     d) What are the important factor that affects the fatigue strength of a material.
     e) State the advantages of V-belt over the flat belt drives.
     f) Justify the statement that 'Curved beams cannot be designed by applying the simple
       bending theory of straight beams'.

Q.2 a) Show the systematic classification of operational joints used in Mechanical systems.   (5)
     b) Design a cotter joint to transmit a load of 90 kN in tension or compression. Assume the
     following stresses for socket, spigot and cotter:
     Allowable tensile stress = 90 N/mm^2
     Allowable crushing stress = 170 N/mm^2
     Allowable shear stress = 60 N/mm^2 (15)

Q.3 a)) A C-clamp, as shown in figure 1 has trapezoidal threads of 12 mm outside diameter and
2 mm pitch. The coefficient of friction for screw threads is 0.12 and for the collar is 0.25. the
mean radius of the collar is 6 mm. If the force exerted by the operator at the end of the handle is
80 N, find:
   i) the length of the handle   ii) the maximum shear stress in the body of the screw and where
     does this exist: and   iii) the bearing pressure on the threads.   (13)
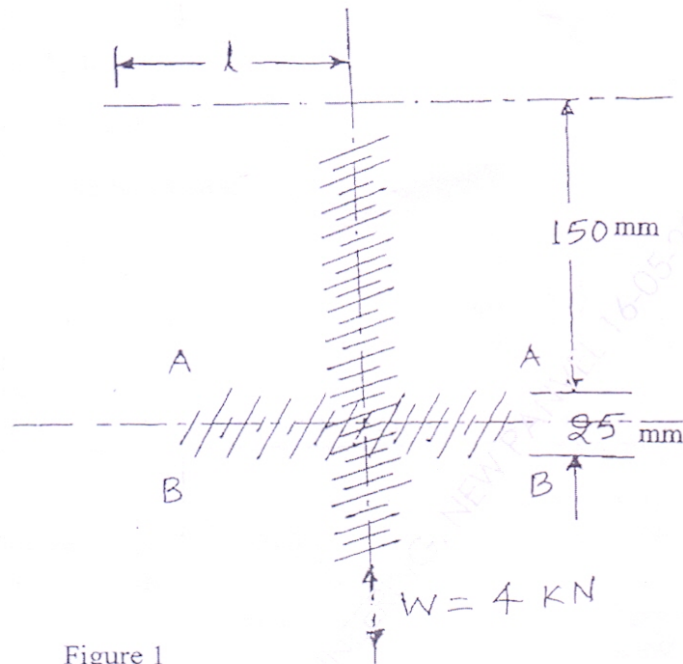
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Figure 1

b) A 50 mm diameter solid shaft is welded to a flat plate as shown in figure 2. If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.   (7)
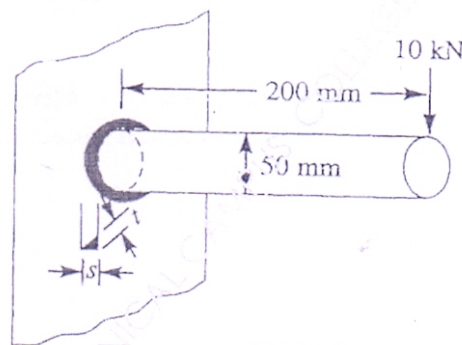

Figure 2

Q.4 a) The mechanical component is subjected to the following bending stress cycles:

       i) ± 300 N/mm^2 for 70 % of time;

       ii) ± 450 N/mm^2 for 5 % of time.

       iii) ± 250 N/mm^2 for remaining time.

The component is made of plain carbon steel 50C4 ($S_{ut} = 660$ N/mm^2). If the endurance limit of the component is 270 N/mm^2, determine its life.   (12)

b) Explain the S-N curve for fatigue life   (8)

Q.5 a) Find the diameter of a solid steel shaft to transmit 20 kW at 200 rpm. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8.

If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5   (8)

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b) A bushed-pin type flexible flange coupling is used to transmit 25 kW power at 1440 rpm from an electric motor to a machine. Design the coupling, if the peak torque is 15 % more than the average torque. Assuming suitable materials and permissible stresses for the components of coupling. Take permissible bearing pressure = $1.2 N/mm^2$ (12)

Q.6 a) A helical compression spring is to be designed for a maximum load of 10 kN with a corresponding deflection of 100 mm. Determine:
  i) the wire diameter;   ii) the number of active turns ; iii) free length; iv) pitch length ;
  v) helix angle.
  For the spring material, assume: $S_{ut} = \frac{2000}{d^{0.168}}, N/mm^2$;

$$S_{ys} = \frac{1200}{d^{0.168}}, N/mm^2 ; \quad G = 8 \times 10^4 N/mm^2$$

  Assume average service (10)

b) A leaf spring has 10 number of leaves, two of which are extra full length. The spring supports are 1 m apart and the central band in 80 mm wide. The central load is 5 kN, with permissible stress of 265 N/mm^2 . The ratio of total depth of the width is 3. Determine:
i) the thickness and width of leaves ; and   ii) the deflection of spring. (10)

Q.7 a) A flat belt drive is to be used to drive a reciprocating compressor running at 800 rpm. by a 18 kW , 1440 r.p.m., electric motor. The required centre distance is 2.2 m. Select the flat belt for the drive. From the manufacturer's catalogue, the power rating per mm width of the belt per ply at 180^0 arc of contact and 10 m/s belt speed is 0.023 kW. (15)

b)State the advantage and disadvantage of the chain drive over belt drive. And what do you understand by simplex, duplex and triplex chains. (5)