

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part. Use of a design data book is not allowed.

x-x-x

I. Write briefly:

(2x5)

- What is factor of safety. Why is it necessary to use factor of safety.
- What is endurance limit. What are the different factors affecting the endurance limit of a machine component.
- State two advantages and disadvantages of welded joint over riveted joint.
- What do you understand by the term equivalent bending moment and equivalent twisting moment for a shaft.
- What are the commonly used thread forms in power screws. Give one practical application for each type.

PART A

II. a) What is S-N curve. How is it obtained. What is its importance in Machine Design. (4)

b) Determine the diameter of a circular rod made of ductile material with a endurance limit, $S_e = 265$ MPa and a tensile yield strength, $S_{yt} = 350$ MPa. The member is subjected to a varying axial load from $W_{min} = -300 \times 10^3$ N to $W_{max} = 700 \times 10^3$ N and has a stress concentration factor = 1.8. Use factor of safety as 2.0. (6)

III. In a Hartnell governor, the length of the ball arm is 190 mm, that of the sleeve arm is 140 mm, and the mass of each ball is 2.7 kg. The distance of the pivot of each bell crank lever from the axis of rotation is 170 mm and the speed when the ball arm is vertical, is 300 r.p.m. The speed is to increase 0.6 per cent for a lift of 12 mm of the sleeve.

- Find the necessary stiffness of the spring.
- Design the bell crank lever. The permissible tensile stress for the material of the lever may be taken as 80 MPa and the allowable bearing pressure at the pins is 8 N/mm². (10)

IV. a) A bracket as shown in the Fig. is welded to a plate. The welds have the same size and the permissible force per mm of the weld length is 1kN. Calculate the lengths l_1 and l_2 .

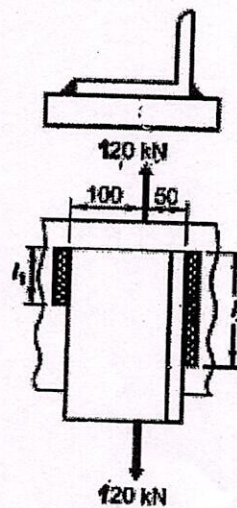


Fig. 1

(6)

b) What is the bolt of uniform strength. How can it be obtained from an ordinary bolt. (4)

(2)

PART B

- V. A shaft is supported by two bearings placed 1m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley. (10)
- VI. (a) Two shafts made of plain carbon steel are connected by a rigid protective type flange coupling. The shafts are running at 500 r.p.m. and transmit 25 kW power. Design the coupling completely for over load capacity 25 per cent in excess of mean transmitted torque capacity. Assume the following permissible stresses for the different components
 Shaft and Key: Permissible tensile stress = 60 MPa; Permissible shear stress = 35 MPa
 permissible compressive strength = 60 MPa
 Bolts: Six numbers made of steel having permissible shear stress = 28 MPa
 Flanges: Cast iron having permissible shear stress = 12 MPa
 Draw two views of the coupling you have designed. (8)
- (b) Discuss about the different stresses induced in a key. (2)
- VII. A cross bar of a planer weighing 9 kN is raised and lowered by means of two square threaded screws of 40 mm outside diameter and 6 mm pitch. The screw is made of steel and nut of phosphor bronze having 42 mm height. A steel collar bearing with 30 mm mean radius takes the axial thrust. The coefficient of friction at the threads and at the collar may be assumed as 0.14 and 0.10 respectively. Find the force required at a radius of 120 mm of a hand wheel to raise and lower the load. Find also the shear stress in the nut material and the bearing pressure on the threads. (10)