Time: 3 Hours **Total Marks: 80**

Instructions:

i. Question **No.1** is **compulsory.**
ii. Attempt **any 3** out of the remaining questions
iii. Use of recommended Design data book is permitted.
iv. Use your judgement for unspecified data, if any.
v. Numbers to the right indicate marks.

Q1. Attempt any four of the following sub questions: (20)

a. What do you mean by the following terms (5)
i.)50C8 ii) 40Ni2Cr1Mo15 iii.) Sq 30x6
iv.) GCI-20 v.) Tr 40x7

b. What do you mean by self-locking and overhauling of screws? Show that the efficiency of self - locking screws is less than 50%. (5)

c. State the significance of the aesthetic considerations in design. (5)

d. What are the different theories of failure? Elaborate any one. (5)

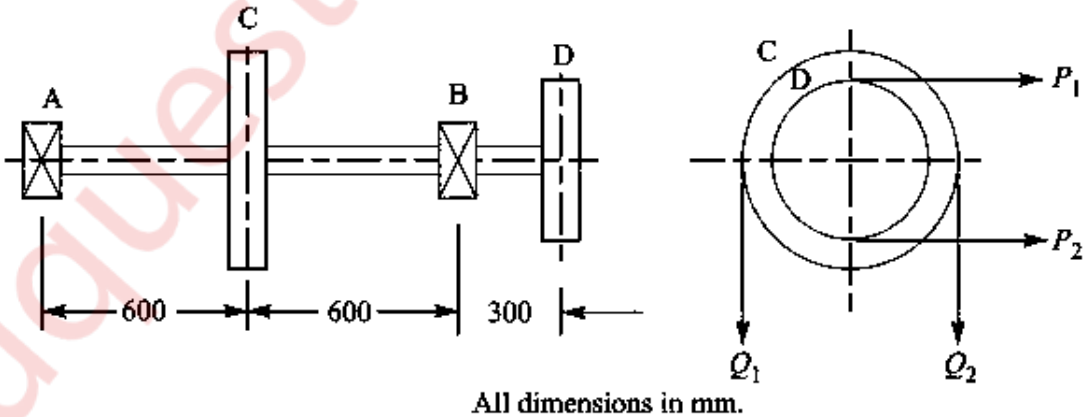
e. What do you mean by nipping of leaves? Is it always necessary? (5)

Q2.a Design a Knuckle joint subjected to an axial pull of 10KN. Selecting suitable material for all the parts decide the allowable stresses. Design should include figures for the Joint and failure areas? (14)

Q2.b Compare the stiffness of a hollow shaft of same external diameter as that of solid shaft. The internal diameter of hollow shaft being half of the external diameter. Both shafts have same material and length. (6)

Q3.a A solid rod of 50mm diameter is welded to a flat plate in the form of a cantilever and subjected to bending moment of 2KN-m and a twisting moment of 3.5KN-m. Determine the size of weld if shear stress in the weld material is limited to 50Mpa? (6)

Q3.b A horizontal shaft AD is supported in bearings A and B and carrying pulleys at C and D is to transmit 75KW of power at 500 rpm from drive pulley D to take off pulley C as shown in figure Calculate the diameter of shaft. Assume the following data Ratio of tensions in Pulley D: $P_1=2P_2$ both horizontal, Radius of pulley C : 220mm
Ratio of tensions in Pulley C: $Q_1=2Q_2$ both vertical , Radius of pulley D : 160mm
Allowable Shear stress for shaft material : 45MPa (14)



All dimensions in mm.

Q4.a What do you mean by endurance limit? How the endurance limit of a component is decided? (5)

Q4.b Design a Pin bush type flexible coupling to transmit 5 KW of power from an electric motor running at 960 rpm to a centrifugal pump. Design should include design of Shaft, Selection of Key, Flange, Bolts and Bush. (15)

Q5.a A machine component is subjected to two dimensional stresses. The tensile stress in X direction varies from 40 to 100 MPa , while tensile stress in Y direction varies from 10 to 80 MPa. The frequency of variation of these stresses is equal. The corrected endurance limit of the component is 270 MPa. The ultimate tensile strength of the material of the component is 660 MPa. Determine the FOS used by the designer. (10)

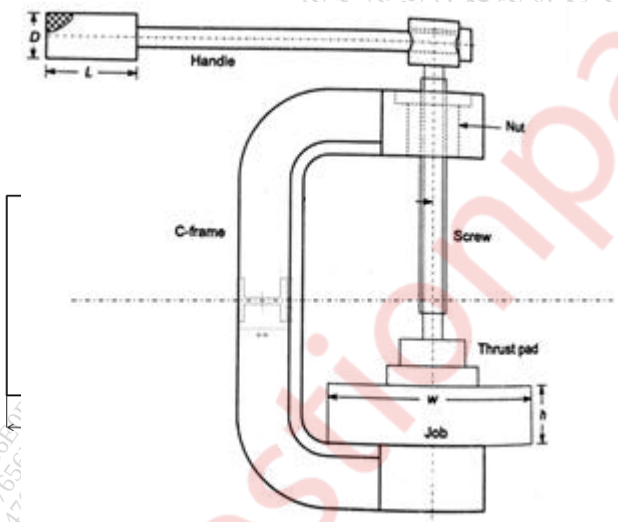
Q5.b. The piston rod of a hydraulic cylinder exerts an operating force of 10KN. The friction due to piston packings and stuffing box is equivalent to 10% of the operating force. The pressure in the cylinder is 10 MPa. The cylinder is made up of cast iron FG200, taking an F.O.S of 5 determine the thickness of the cylinder? (5)

Q5.c What do you mean Surge in Springs? How it can be avoided? (5)

Q6.a A helical compression spring is subjected to a maximum force of 5000N with a corresponding deflection of 70mm. The spring is to operate over a 50mm diameter rod. Determine the wire diameter and number of active turns. Also decide other details such as free length, pitch, helix angle. Check for solid stress and buckling. State whether the spring is a closed coiled helical spring. For the material of the spring assume following properties (12)

$$S_u = \frac{2000}{d^{0.17}} MPa \quad S_{ys} = \frac{1200}{d^{0.17}} MPa \quad G = 80GPa$$

Q6.b Design the frame of a C-clamp to exert a clamping force of 5KN as shown in figure below. Assume the cross section of frame as I section with web=9t flange =6t, where 't' is the thickness of the flange and web of the 'I' section of the clamp body. Distance of the centroidal axis of the frame from the load axis is 150mm. Use the Curved beam approach. (8)



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