(3 hours) [Total Marks: 80]

N.B. 1) Question **No. 1 is compulsory**.
2) Attempt **any Three questions** from the remaining five questions.
3) Assume any suitable data if necessary with justification.
4) Use of PSG data book and Design data book by Mahadevan is permitted.
5) Draw neat sketches to support your answer wherever necessary.

Q. 1 Write Short Notes on (Any Four) **20**

a) Discuss about the different types of welded joints and their strength with sketches.

b) Discuss the bolts of uniform strength giving examples of practical application of such bolt.

c) Stress distribution in compound cylinder subjected to internal pressure

d) Factor of safety and factors considered for its selection

e) Discuss the importance of wahl's factor in the design of helical spring.

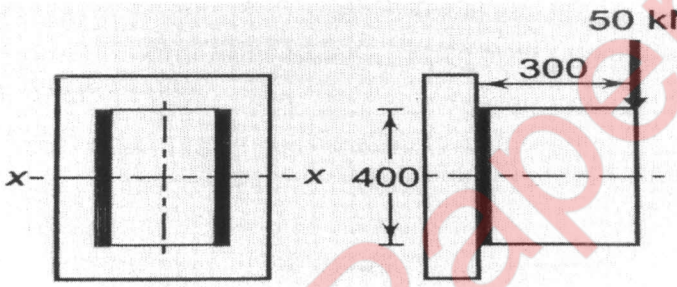
Q. 2 a) Design knuckle joint to transmit an axial load of 50 kN. Select appropriate material for its components and draw its neat sketch showing major dimensions on it. **12**

b) A semi –elliptic multileaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full length leaves and ten graduated length leaves including the master leaf. The center to center distance between the spring eyes is 1.2 m. the leaves are made of 55Si2Mo90 (S_{yt} = 1500 N/mm^2 and E = 207000 N/mm^2) and the factor of safety is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are prestressed so as to equalize stresses in all leaves, **8**
Determine i) the cross section of leaves, and ii) the deflection at the end of the spring.

Q. 3 a) A steel shaft transmitting 25 kW at 300 rpm is supported on a two bearings 800 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 150 mm to the left of right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 200 mm to the right of left hand bearing and receives power from below in vertical direction. Design suitable diameter shaft, allowing safe stress is 60 N/mm^2 in shear. **10**

b) A cylindrical steam pressure vessel of 1m inside diameter is subjected to an internal pressure of 2.5 Mpa. Design a double- riveted, double strap longitudinal butt joint for the vessel. The strap are of equal width. The pitch of the rivets in outer row should be twice of the pitch of rivet in inner row. Zigzag pattern is used for rivets in inner and outer rows. The efficiency of the riveted riveted joint should be at least 70%. The permissible tensile stress for the steel plate of pressure vessel is 80 N/mm^2. The permissible shear stress for the rivet material is 60 N/mm^2. Assume that the joint does not fail by crushing. **10**

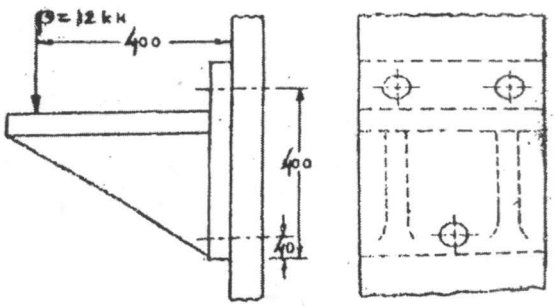
Q. 4 a) A bracket is welded to vertical plate by means of two fillet welds as shown in Figure1. determine the size of the welds, if permissible shear stress is limited to 70 N/mm^2 **10**



(Figure 1)

b) A cylindrical vessel is meant for storing liquefied gas at pressure of 15 N/mm^2 has an inner diameter 250 mm. ultimate tensile strength of material of the vessel 350N/mm^2. Design the wall thickness required for the vessel to sustain the above pressure. Also determine the radial and tangential stresses across the wall the vessel at inner, outer and middle points. **10**

Q. 5 a) A bracket is attached to column by means of three bolts as shown in figure2. Calculate the size of bolts used if the permissible tensile and shear stresses are 75 N/mm^2 and 55 N/mm^2 respectively. The eccentric load on the bracket is 12 kN at an eccentricity of 0.4 m. the distances from the center of the bolts to the edge of the bracket are shown in figure 2. **10**



(figure 2)

b) A tensioning device is to be designed to sustain an axial pull of 30 kN and to permit an axial adjustment of at least 80 mm. Design and sketch the arrangement, selecting appropriate materials and stresses with justification thereof. **10**

Q. 6 a) It is required to design a bushed- pin type flexible coupling to connect the output shaft of an electric motor to shaft of centrifugal pump. The motor delivers 25 kW power at 800 rpm. The starting torque of the motor can be assumed to be 150% of the rated torque. Design the coupling and specify the dimensions of its components with suitable material. **12**

b) A crane hook, with a bed diameter of 180 mm is designed to support a load of 90 kN. The critical section of the crane hook, in simplified form, is trapezoidal having 100 mm and 40 mm as lengths of its parallel sides and 120 mm as its depth. Compute maximum and minimum stresses at the inner and outer sides of the critical section. Sketch with proportions the actual shape the critical section. **8**

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