SE. Sem IV / Prod / Engg. Design / Dec 09

Con. 5414-09. **(REVISED COURSE)** **SP-7778**

(4 Hours) **[Total Marks : 100**

N.B. (1) Question No.**1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable** data if **required**.
(4) **Design** data books are **not allowed**.

1. (a) A shaft is supported by two bearings placed 1 m 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 by electric with belt which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and $\mu = 0{\cdot}24$. Determine the suitable diameter of the shaft, allowing stress of 65 MPa in tension and 40 MPa in shear for the material of the shaft. **15**
   (b) Design the rectangular key for a shaft of 50 mm diameter. Take crushing and shearing stresses for the material of the key as 70 MPa and 40 MPa respectively. **5**

2. (a) Design a split muff coupling to transmit 30 kW at 100 rpm. The allowable shear stress for the material of shaft and key is 40 MPa. The number of bolts connecting the two halves are six. The allowable tensile stress for the material of bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0·3. **10**
   (b) Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1·5 m in diameter subjected to a steam pressure of 0·95 N/mm^2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa, compressive stress 140 MPa and shear stress in the rivet 60 MPa. **10**

3. (a) Design a knuckle joint to transmit 150 kN. Take the design stresses as 75 MPa in tension, 60 MPa in shear and 15° MPa in compression. **14**
   (b) A mild steel bar supports a tensile load of 50 kN. If the stress in the bar is to be limited to 100 MPa, find the size of the bar when the cross section is — **6**
   (i) circular and (ii) square.

4. (a) Design an I-section connecting rod for an I. C. engine using the following data :— **14**

Diameter of piston	—	100 mm
Stroke length	—	120 mm
Maximum engine speed	—	3000 rpm
Maximum explosion pressure	—	3·5 N/mm^2
Weight of reciprocating parts	—	20 N
Length of connecting rod from centre to centre	—	300 mm
Density of the material of rod	—	80 KN/m^3
Yield stress of the material of rod	—	330 N/mm^2
Factor of safety	—	3

   (b) A cast iron cylinder of internal diameter 300 mm and thickness 40 mm, is subjected of an internal pressure of 5 N/mm^2. Calculate the tangential and radial stresses at the inner and outer surfaces of the cylinder. **6**

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(b) A pair of straight teeth spur gear having 20° full depth involute teeth is to transmit 12 kW at 300 rpm of the pinion. The speed ratio is 3:1. The allowable static stresses for gear of cast iron and pinion of steel are 60 MPa and 105 MPa respectively. Use the following data :— **10**

Number of teeth of pinion = 17

Face width = 10 times module

Velocity factor, $C_v = \frac{4{\cdot}5}{4{\cdot}5 + V}$, V – velosity in m/s

Form factor, $Y = 0{\cdot}154 - \frac{0{\cdot}912}{Z}$, Z– number of teeth.

Determine module, face width and PCD of gears.

7. Write short notes on any **four** of the following :— **20**

(a) Steps in design

(b) Factor of safety

(c) Bolts of uniform strength

(d) Stresses in helical springs of circular wire

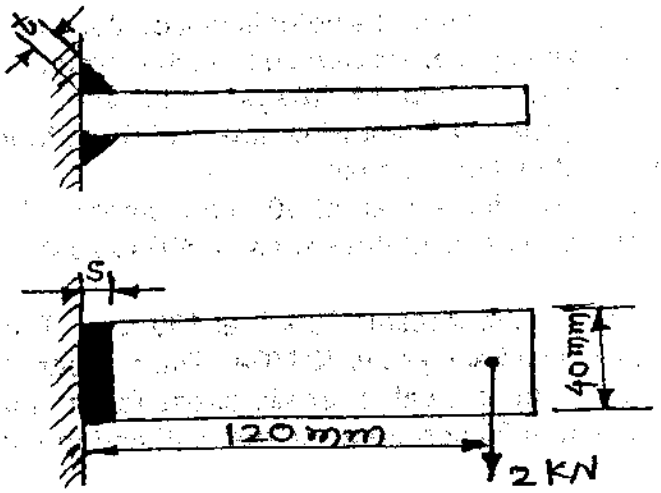
(e) Types of riveted joints.

5. (a) Design a leaf spring for the following specifications :— 10

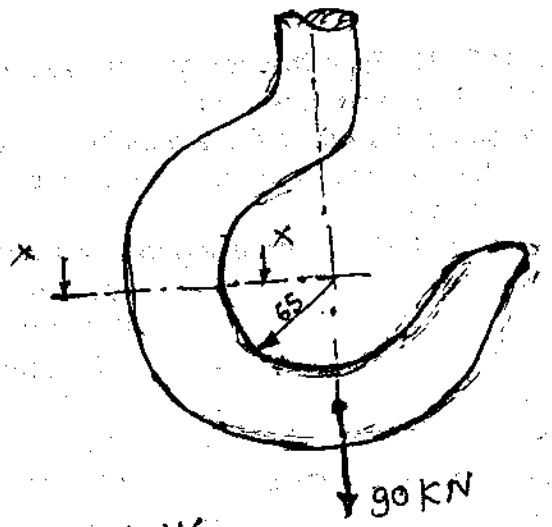
Total load	=	140 kN
Number of springs supporting the load	=	4
Maximum number of leaves	=	10
Span of the spring	=	1 m
Permissible deflection	=	80 mm

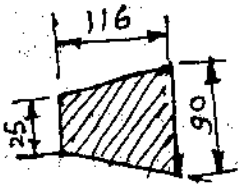
Take Young's modulus as 200 kN/mm^2 and allowable stress in the spring material as 600 N/mm^2.

(b) A welded joint as shown in **figure** below, is subjected to an eccentric load of 2 kN. Find the size of weld, if maximum shear stress in the weld is 25 MPa. 10



6. (a) A crane hook has a trapezoidal section at x-x as shown in **figure** below. Determine the resultant stress at the inner surface. 10





section at X-X

All dimensions are in mm.