Sem-V / Engg. Design. / PROD / 11-12-15

QP Code : 5728

(3 Hours)

Total Marks: - 80

N.B. : (1) **Question No. 1 is compulsory.**

(2) Attempt **any three** questions out of the remaining five questions.

(3) Figures to the right indicate full marks.

(4) Furnish neat design sketches wherever necessary.

(5) Use of PSG design data book is permissible.

1 Attempt **any four** of the following:-

(a) Elaborate on factor of safety and its implications in designing. 05

(b) Indicate various stresses to which a helical tension/compression spring is subjected to, when loaded. Why Wahl's stress factor is considered in designing helical tension/compression springs? 05

(c) Explain the various modes of failure of riveted joints, with relevant sketches and stress equations. 05

(d) A metallic cylinder having 380 mm and 300 mm as its outside and inside diameters respectively is subjected to an internal pressure of 5 N/mm^2. Determine the tangential and radial stress at the inner and outer walls of the cylinder. 05

(e) Explain how would you check for the bending stress induced in the cotter of a cottered joint. Bring out the significance of this check. 05

2. (a) Design a knuckle joint for connecting two rods and to sustain an axial load of 25kN. Assume appropriate materials and stresses of your own, with due justification, for various components of the joint. 12

(b) A curved frame is subjected to a force of 5kN acting as shown in figure. Determine the resultant stresses at the inner and outer surfaces at section X-X as indicated in the figure. 08

3. (a) The shaft of a 30kW, 800 rpm, D. C. motor is 750mm from centre to centre of the bearings. The magnetic pull on the armature is equivalent to a uniformly distributed total load of 6.25kN distributed over the middle one-third length of the shaft. The permissible stresses in shear & tension for the shaft material are 45 N/mm^2 and 70 N/mm^2 respectively. Design a suitable diameter for this shaft. 12

(b) A plate 80 mm wide and 10 mm thick is to be joined to another plate by a transverse weld and double parallel fillet welds. The max allowable stresses in tension and shear are 80 N/mm^2 and 60 N/mm^2 respectively. Find the length of each parallel fillet weld. Assume that the joint is subjected to static loading and the weld size is equal to plate thickness. 08

Turn Over

4. (a) A spur gear set comprising of a pinion and gear wheel is to be connected between a motor of 18kW rating running at 1400 rpm and a compressor running at 350 rpm. The gear tooth are of full depth with 14.5° involute profile. The pinion has 40 teeth and is made from forged steel having allowable stress of 200 N/mm². The gear is made of cast steel having permissible stress of 135 N/mm². Design the module, face width and number of teeth both for the pinion and gear wheels. Take the face width of the gears as 10 times the module. A service factor of 1.5 may be assumed. Tooth form factor, $y = 0.124 - \frac{0.684}{no.of\ teeth}$ and velocity factor $= \frac{6}{6+v}$, where v = pitch line velocity in m/sec. **12**

(b) Explain the step to step procedure of designing a rivetted joint for welding the longitudinal seams of a pressure vessel, as per Indian Boiler Regulations. Provide appropriate design sketches and indicate relevant stress equations. **08**

5. (a) Design a helical compression spring for a spring loaded safety valve from the following specifications: **10**
Operating pressure = 1 N/mm²
Max. pressure when valve blows off freely = 1.075 N/mm²
Max. lift of the valve at blow off pressure = 6mm
Diameter of valve seat = 100 mm
Max. shear stress permitted in material of the spring wire= 400 N/mm²
Modulus of rigidity for the material of the spring wire = 86kN/mm²
Spring index= 6
Prepare a neat sketch of the spring that you have designed, showing the end connections.

(b) Design a flanged coupling to connect two plain carbon steel shafts transmitting 25kW at 500 rpm. Assume the following safe stresses for the various components of the coupling. **10**
Shaft – f_t= 60 N/mm² and f_s= 40 N/mm²
Key – f_s= 40 N/mm² and f_c= 80 N/mm²
Bolts – f_s= 25 N/mm²
Flanges – f_s= 15 N/mm²
Provide provision for 25% overload capacity.
Explain why low stress value is taken for design of bolts?

6. A bracket is fixed to a vertical column using five bolts as shown.
a) Design the size of the bolts required to sustain a force of 45kN, acting as indicated. **14**
b) Also design the thickness of the arm of the bracket.
Take, f_t= 70 N/mm² and f_s= 50 N/mm² **06**