Sem V / Engg Design / PROD / CBGS / NOV-2016 / 19-12-16

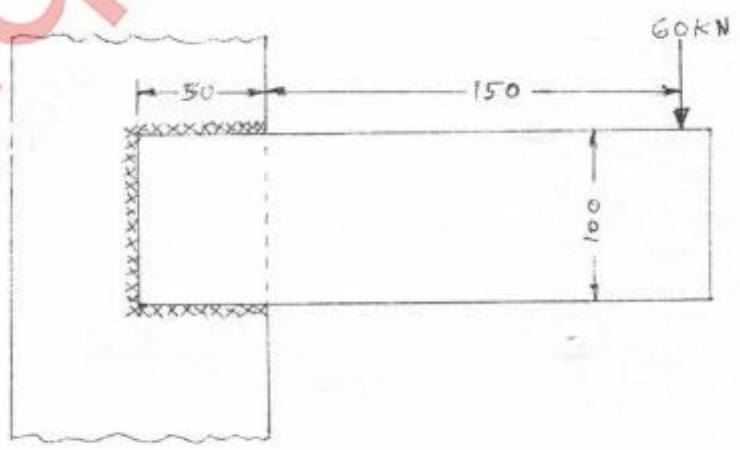
QP Code : 608502

(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) Figures to the right indicate full marks.
(5) Use of design data books such as PSG, Mahadevanare permitted.
(6) Draw neat sketches to support your answer wherever necessary.

1. Attempt **any four** of the following:-
   (a) Elaborate on design safety and its significance. What are the guide lines and criteria to decide upon the factor of safety? **5**
   (b) Explain with sketches probable failure modes of the pin of a bushed pin type flexible coupling, indicating various loads and stresses to which the pin is subjected to. **5**
   (c) What is the significance of determining the beam strength of a spur gear tooth? How would you check the safety of a spur gear tooth for wear load? **5**
   (d) Explain what is meant by efficiency of riveted joint. How would you determine the same? **5**
   (e) Explain the need and significance of using Wahl's stress factor in designing helical compression and tension springs. **5**

2. (a) A tensioning device is to be designed to sustain an axial load of 25 kN and to permit an axial adjustment of at least 60 mm. Design and sketch the arrangement, selecting appropriate materials and stresses with justification thereof. **10**
   (b) A horizontal bracket supporting a load of 60 kN is welded on to a vertical member using three fillet welds as indicated in the figure. Design the size of the weld to be used. The stress in the throat section of the weld is not to exceed 140 N/mm^2. **10**



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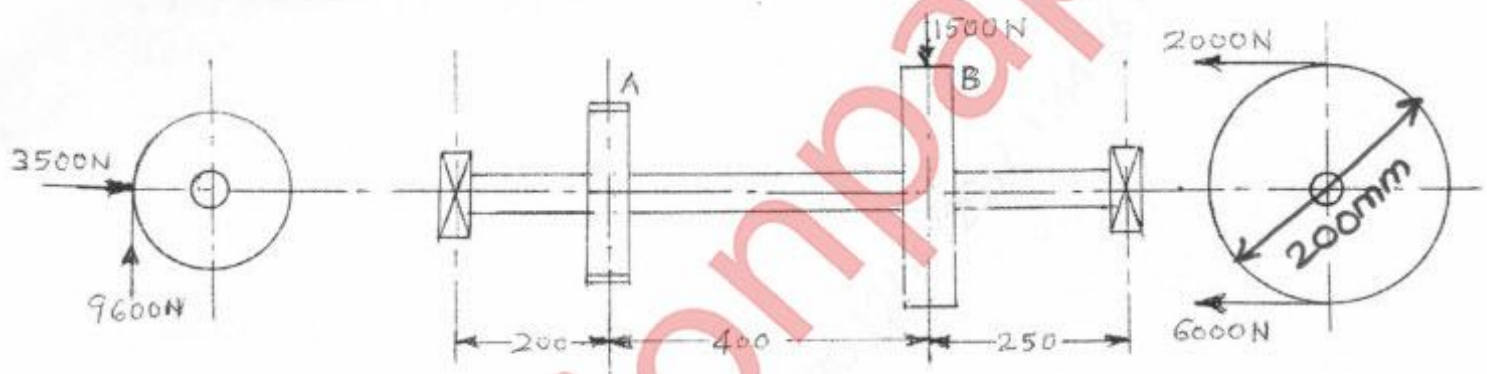
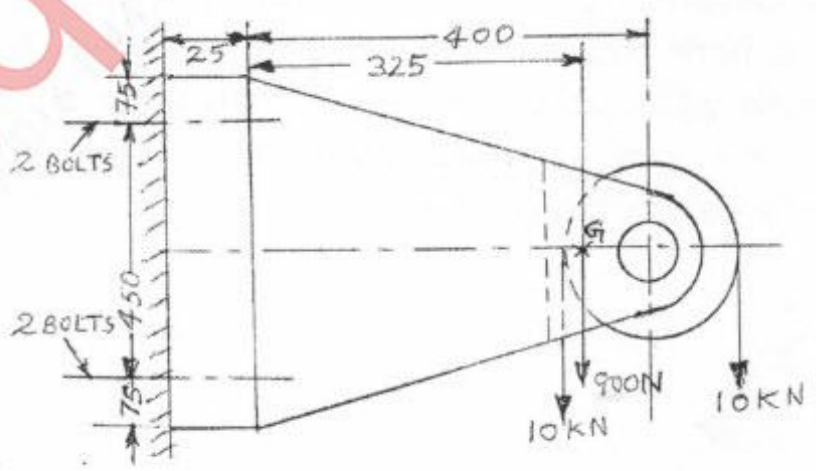
3. (a) Design and sketch a muff coupling to transmit 60 kW at 180 rpm. Assume design stresses as under, Shear stress in shaft and key= 40 N/mm^2 Shear stress in muff= 15 N/mm^2 Crushing stress in key= 90 N/mm^2. **8**

(b) A power transmission shaft is mounted on two bearings located 850 mm apart. The shaft carries a gear 'A' at 200 mm to the right of left hand bearing and a pulley 'B' at 250 mm to the left of right hand bearing. The gear is subjected to horizontal pressure of 3500 N and a vertical upward pressure of 9600 N as indicated. The pulley is driven by a flat belt drive having 6000 Nand 2000 N as tensions in the tight side and slack side respectively. The pulley weighs 1500 N. Design the size of the shaft. Safe shear stress in the material of the shaft may be taken as 45 N/mm^2. Take shock factor (k_t) = 1.5 and fatigue factor (k_m)= 2. **12**



4. (a) A pulley bracket weighing 900 N (along with its fitting) is to be connected to a vertical structure using four bolts as shown in figure. Determine the size of the bolts required to support the bracket which is loaded as indicated. The material of the bolt will permit stresses of 70 N/mm^2 in tension and 40 N/mm^2 in shear. **10**



(b) Design a closed helical spring to sustain service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. The permissible shear stress intensity in the material of spring wire is 420 N/mm2 and modulus of rigidity is 84 kN/mm^2. The spring index may be taken as 5. The spring ends are to be squared and ground. Prepare a neat design sketch of the spring that you have designed, bringing out the details of the end connections. **10**

5. (a) Design a spur gear drive for transmitting 25 kW at 400 rpm of the pinion. Use the following particulars, **12**
Velocity ratio = 1 : 2
Allowable static stress for pinion material= 150 N/mm2
Allowable static stress for gear material = 120 N/mm2
No. of teeth on pinion. = 20
Face width = 14 times module
Tooth profile = 20°, full depth involute

$$\text{Tooth form factor, } Y = 0.154 - \frac{0.912}{\text{No of teeth}}$$

$$\text{Velocity factor, } K = \frac{3}{3+V}, \text{ 'V' in m/s.}$$

(b) A crane hook, with a bed diameter of 130 mm is designed to support a load of 90 kN. The critical section of the crane hook, in simplified form, is trapezoidal having 90 mm and 25 mm as lengths of its parallel sides and 116 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**

6. (a) Design a double riveted, double strap butt joint for the longitudinal seam of a boiler shell of 750 mm diameter. The shell is to resist a maximum operating pressure of 1.05 N/mm^2 (gauge). The allowable stress are f_t = 35 N/mm^2; f_s = 28 N/mm2 and f_c = 56 N/mm^2. The efficiency of the joint is to be 75%. The design should confirm to Indian Boiler Regulations (IBR). **10**

(b) A shrink fit assembly is formed by shrinking one cylinder over another. Before applying any internal pressure, the internal and external diameters of the assembly are 120 mm and 200 mm respectively and the diameter at the common junction is 160 mm. The contact pressure developed at the junction of the assembly after shrinking is 8 N/mm^2. If the assembly is now subjected to an internal pressure of 60 N/mm^2 estimate the stresses developed at inner, mating and outer surfaces of the assembly. Take $E = 200 \times 10^3$ N/mm^2. **10**

(c) Sketch the probable stress distribution along the walls of the cylinders. **2**
