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**B.Tech. Degree VI Semester Special Supplementary Examination  
January 2016**

**ME 603 MACHINE DESIGN I  
(2006 Scheme)**

Time : 3 Hours

Maximum Marks : 100

(Use of approved design data book is permitted,  
Data not given may be suitable assumed)

**PART A**

(Answer ALL questions)

(8 × 5 = 40)

- I. (a) Explain six factors which govern the design of machine parts.  
 (b) Explain the following.  
     (i) Notch sensitivity  
     (ii) Stress concentration factor.  
 (c) Explain Knuckle joint and give its typical applications.  
 (d) What is self locking of power screw? What is the condition of self locking?  
 (e) Write short notes on.  
     (i) Lozenge joint (ii) Caulking and Fullering.  
 (f) What is surge in spring? Explain the methods to avoid surge in springs.  
 (g) Explain different types of butt welded joints with neat sketches.  
 (h) A hollow shaft has greater strength and stiffness than a solid shaft of same weight. Explain.

**PART B**

(4 × 15 = 60)

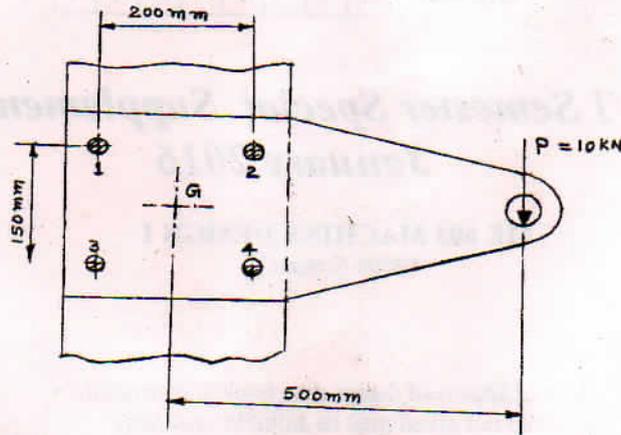
- II. A pulley is keyed to a shaft midway between two antifriction bearings. The bending moment at the pulley varies from – 170 N-m to 510 N-m and the torsional moment in the shaft varies from 55 N-m to 165 N-m. The frequency of the variation of the loads is the same as the shaft speed. The shaft is made of cold drawn steel having an ultimate strength of 540 MPa and yield strength of 400 MPa. Determine the required diameter for an indefinite life. The stress concentration factor for the keyway in bending and torsion may be taken as 1.6 and 1.3 respectively. The factor of safety is 1.5. Take size factor = 0.85 and surface finish factor = 0.88. (15)

**OR**

- III. (a) What is the difference between failure due to static load and fatigue failure? (3)  
 (b) A machine component is subjected to fluctuating stress that varies from 30 MPa to 90 MPa. The corrected endurance limit stress for the machine component is 240 MPa. The ultimate tensile strength and yield strength of the material are 540 MPa and 400 MPa respectively. Find the factor of safety using: (12)  
     (i) Gerber theory.  
     (ii) Soderberg line.  
     (iii) Goodman line.

Also find the factor of safety against static failure. Neglect stress concentration effect and other correction factors.

- IV. The structural connection shown in figure is subjected to an eccentric force P of 10 kN with an eccentricity of 500 mm from the CG of the bolts. The centre distance between bolts 1 and 2 is 200 mm, and the centre distance between bolts 1 and 3 is 150 mm. All the bolts are identical. The bolts are made from plain Carbon steel having yield strength = 400 MPa and the factor of safety is 2.5. Determine the size of bolts. (15)



OR

- V. Design a rigid type of flange coupling for connecting two shafts. The input shaft transmits 50 kW power at 240 rpm to the output shaft through the coupling. The service factor for the application is 1.5. Assuming that the shafts, keys and bolts are made of same grade steel and have following permissible stresses: tensile  $\sigma_t = 160 \text{ MPa}$ , shear  $\tau = 80 \text{ MPa}$  and crushing  $\sigma_c = 240 \text{ MPa}$ . Also assume that the flanges are made of cast iron and have permissible shear stress  $\tau = 16 \text{ MPa}$ . Draw a neat sketch showing all dimensions. (15)

- VI. (a) Find the efficiency of the following joints. (10)
- Single riveted lap joint of 10 mm plates with 20 mm diameter rivets having a pitch of 55 mm.
  - Double riveted lap joint of 10 mm plates with 20 mm diameter rivets having a pitch of 65 mm.

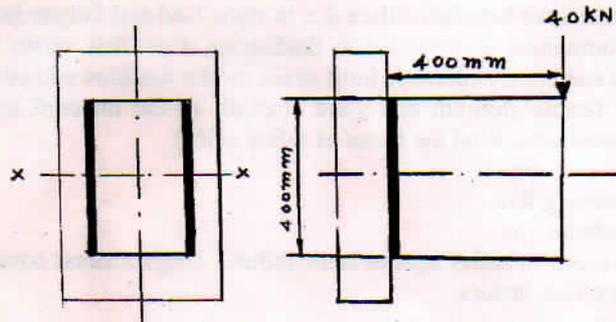
Assume permissible tensile stress in plate = 95 MPa; Permissible shearing stress in rivets = 75 MPa and permissible crushing stress in rivets = 140 MPa.

- (b) Explain the advantages and disadvantages of riveted joints. (5)

OR

- VII. A safety valve, 40 mm in diameter, is to blow off at a pressure of 1.2 MPa. It is held on its seat by means of a helical compression spring, with initial compression of 20 mm. The maximum lift of the valve is 12 mm. The spring index is 6. The spring is made of cold drawn steel wire with ultimate tensile strength of 1400 MPa. The permissible shear stress can be taken as 50% of this strength. Take modulus of rigidity of wire,  $G = 81370 \text{ N/mm}^2$ . Calculate. (15)
- wire diameter
  - mean coil diameter
  - number of active coils.

- VIII. A bracket is welded to the vertical plate by means of two fillet welds as shown in the figure. Determine the size of the welds, if the permissible shear stress is limited to 70 MPa. (15)



OR

- IX. A hollow shaft of 500 mm outside diameter and 300 mm inside diameter is used to drive a propeller of marine vessel. The shaft is mounted on bearings 6000 mm apart and it transmits 5600 kW at 150 rpm. The maximum axial propeller thrust is 500 kN and the shaft weighs 70 kN. Determine. (15)
- The maximum shear stress developed in the shaft
  - The angular twist between the bearings.