

B. Tech Degree VI Semester Examination, April 2010

ME 603 MACHINE DESIGN I

(2006 Scheme)

(Use of approved Design Data Handbook is permitted. Data not given may be suitably assumed. All such assumptions must be clearly stated. Designs should be accompanied by neat dimensional sketches.)

Time : 3 Hours

Maximum Marks : 100

PART A

(Answer ALL questions)

(8 x 5 = 40)

- I.
- What is meant by stress concentration? How do you take it into consideration in case of a component subjected to dynamic loading?
 - What is meant by endurance strength of a material? How the size and surface condition of a component and type of load affect such strength?
 - What is an eccentric riveted joint? Explain the method adopted for designing such a joint.
 - What are flexible couplings and what are their applications? Illustrate your answer with suitable examples.
 - Show that the efficiency of self locking screws is less than 50 percent.
 - Explain A.M.Wahl's factor and state its importance in the design of helical springs.
 - Show that the normal stress in case of an annular fillet weld subjected to bending is

$$\text{given by } \sigma = \frac{5.66Mb}{\pi sd^2}$$

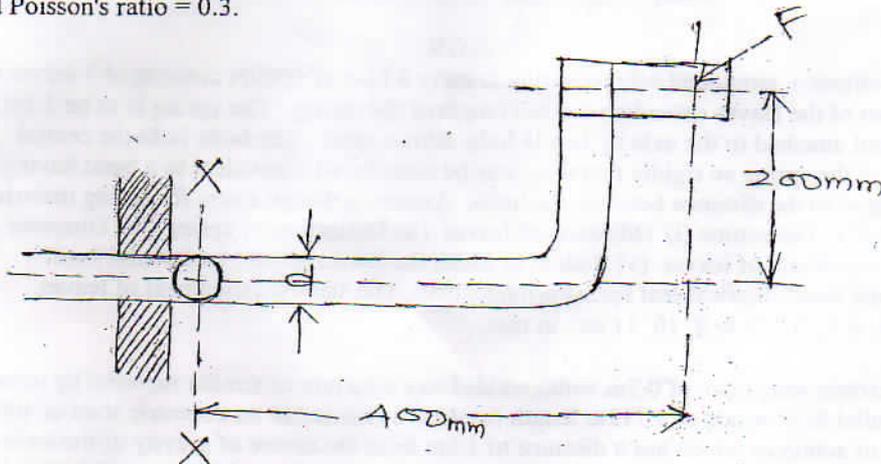
Where Mb=Bending moment, S=Weld size, d=diameter of cylindrical element welded to flat surface.

- A hollow shaft has greater strength and stiffness than a solid shaft of equal weight. Explain.

PART B

(4 x 15 = 60)

- II. A hand cranking lever as shown in figure is used to start a truck engine by applying a force $F=400\text{N}$, the material of the cranking lever is 30g for which yield strength = 320 MPa. Ultimate tensile strength = 500 MPa; Young's modulus = 205 GPa; Modulus of rigidity = 84 GPa and Poisson's ratio = 0.3.



Assuming factor of safety to be four based on yield strength design the diameter 'd' of the lever at section X-X near the guide bush using (i) Maximum distortion energy theory (2) Maximum shear stress theory.

OR

- III. Determine the size of a piston rod subjected to a total load of having cyclic fluctuations from 15kN in compression to 25kN in tension. The endurance limit is 360 MPa and yield strength is 400MPa. Take impact factor = 1.25, factor of safety = 1.5, surface finish factor = 0.88 and stress concentration factor = 2.25.

(Turn over)

IV. A vertical square threads screw of a 70mm mean diameter and 10mm pitch supports a vertical load of 50kN. It passes through the boss of a spur gear wheel of 70 teeth which acts as a nut. In order to raise the load, the spur gear wheel is turned by means of a pinion having 20 teeth. The mechanical efficiency of pinion and the gear wheel drive is 90%. The axial thrust on the screw is taken up by a collar bearing having a mean radius of 100mm. The coefficient of friction for the screw and nut is 0.15 and that for the collar bearing is 0.12, find

- (i) Torque to be applied to the pinion shaft
- (ii) Maximum principal and the shear stresses in the screw
- (iii) Height of nut, if the bearing pressure is limited to 12 N/mm^2

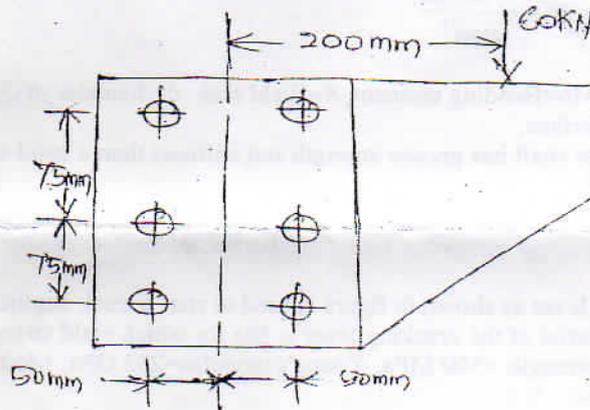
OR

V. Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32KW at 960 r.p.m. The overall torque is 20 per cent more than the mean torque. The material properties are as follows:

- (i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80MPa respectively.
- (ii) The allowable shear stress for the cast iron is 15 MPa.
- (iii) The allowable bearing pressure for rubber bush is 0.8 N/mm^2 .
- (iv) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling.

VI. A bracket is riveted to a column by 6 rivets of equal size as shown in figure. It carries a load of 60kN at a distance of 200mm from the centre of the column. If the maximum shear stress in the rivet is limited to 150MPa, determine the diameter of the rivet.



OR

VII. A semi-elliptical laminated vehicle spring to carry a load of 6000N consists of 7 leaves 65mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1m in length and attached to the axle by two U-bolts 80mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Assume a design stress for spring material as 350 MPa. Determine (i) Thickness of leaves (ii) Deflection of spring (iii) Diameter of eye (iv) Length of leaves (v) Radius to which the leaves should be initially bent. Sketch the semi-elliptical leaf spring arrangement. The standard thickness of leaves are: 5, 6, 6.5, 7, 7.5, 8, 9, 10, 11 etc. in mm.

VIII. A low carbon steel plate of 0.7m width welded to a structure of similar material by means of two parallel fillet welds of 0.112m length (each) is subjected to an eccentric load of 4000N, the line of action of which has a distance of 1.5m from the centre of gravity of the weld group. Design the required thickness of the plate when the allowable stress of the weld metal is 60 MPa and that of the plate is 40 MPa.

OR

IX. The shaft of an axial flow rotary compressor is subjected to a maximum torque of 2000N-m and a maximum bending moment of 4000N-m. The combined shock and fatigue factor in torsion is 1.5 and that in bending is 2. Design the diameter of the shaft, if the shear stress in the shaft is 50MPa. Design a hollow shaft for the above compressor taking the ratio of outer diameter to the inner diameter as 2. What is the percentage saving in material? Also compare the stiffness.