



T.E. (Mechanical) (Semester – I) Examination, 2010
DESIGN OF MACHINE ELEMENTS
(2003 Course)

Time : 4 Hours

Max. Marks : 100

- Instructions :**
- 1) Answers to the **two** Sections should be written in **separate** books.
 - 2) **Neat** diagrams must be drawn **wherever** necessary.
 - 3) **Black** figures to the **right** indicate **full** marks.
 - 4) **Use** of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.
 - 5) Assume suitable data, **if** necessary.

SECTION – I

1. a) Describe the various steps in design of machine elements. Draw the flowchart indicating major steps. 8
b) Differentiate between factor of safety and service factor. 4
c) Write down the first five numbers of R 20 series for the preferred numbers. What are the applications of preferred numbers? 4

OR

2. a) An offset link subjected to a force of 25 kN is shown in figure 1. It is made of gray cast iron FG 300 and the factor of safety is 3. Determine the dimensions of the cross-section of the link. 8

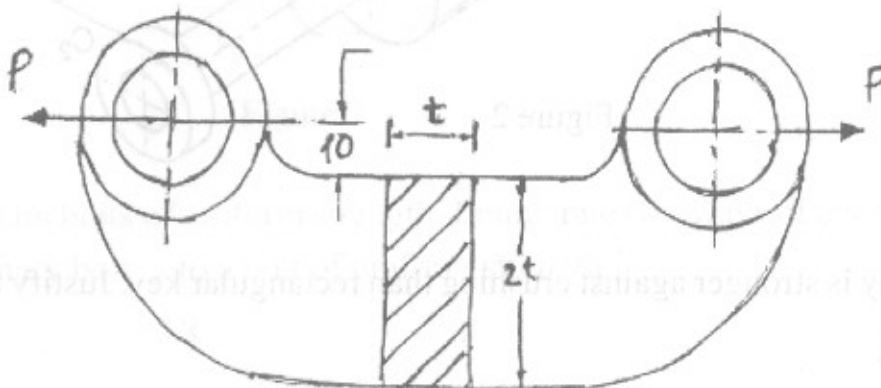


Figure 1



b) With the help of neat sketches, write strength equation for each failure in Knuckle joint.

8

3. a) A gearbox shaft supporting two spur gears A and B and mounted between two bearings C_1 and C_2 is shown in figure 2. The pitch circle diameters of gears A and B are 500 mm and 250 mm respectively. The shaft is made of alloy steel ($s_{ut} = 620 \text{ N/mm}^2$ and $s_{yt} = 480 \text{ N/mm}^2$). The factors K_b and K_t of the ASME code are 2 and 1.5 respectively. The gears are keyed to the shaft. Determine the shaft diameter using ASME code.

12

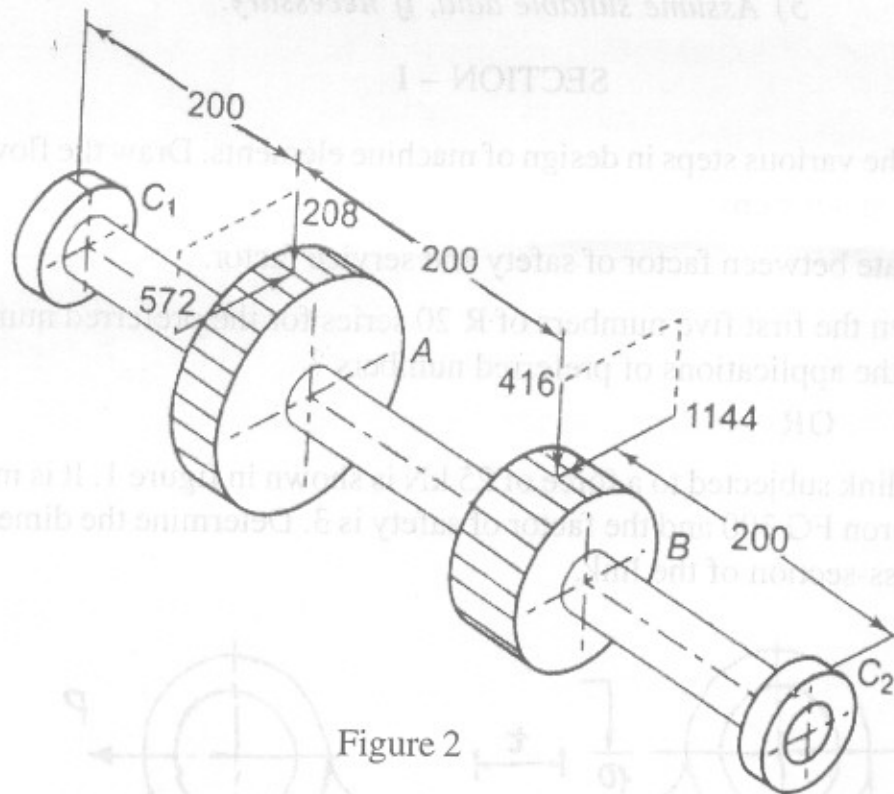


Figure 2

b) Square key is stronger against crushing than rectangular key. Justify the statement.

4

OR



- 4. a) Explain the basic procedure to find out the dimensions of bushed-pin type flexible coupling. Write relevant equations and draw necessary sketches. 10
- b) State the Castigliano's theorem. Explain how this theorem is useful in designing a shaft on the basis of lateral rigidity. 6

- 5. a) A bracket is fastened to the roof truss by means of two identical bolts as shown in figure 3. Determine the minimum core diameter of the bolts, if the permissible tensile stress in the bolts is limited to 75 N/mm^2 . 9

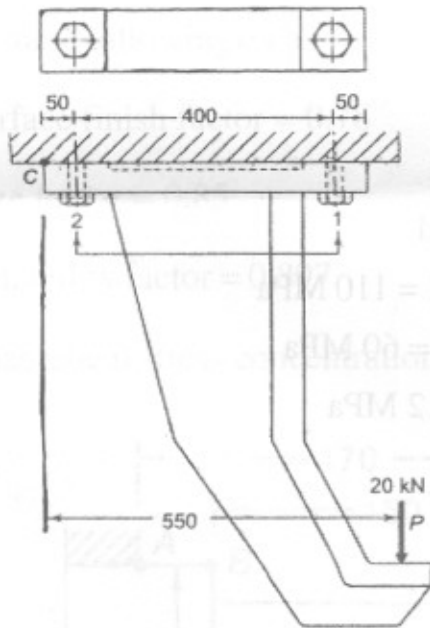


Figure 3

- b) Explain bolts of uniform strength. Enumerate two ways of converting an ordinary bolt into a bolt of uniform strength. 9

OR



6. a) Explain types of welded joints. What are primary and secondary shear stresses in eccentrically loaded welded joint? 9
- b) Determine the weld size of an annular fillet used to weld a circular cantilever shaft of diameter 30 mm and length 100 mm. The force acting at the free end of the shaft is 5 kN and the permissible weld stress is 80 N/mm². 9

SECTION – II

7. a) Derive expressions for torque required to raise the load and to lower the load in case of square threads. 8
- b) Prove that maximum efficiency of self locking square threads is 50%. 4
- c) State the advantages and disadvantages of square threads over trapezoidal threads. 4

OR

8. The following data refers to a 'C' clamp :

Maximum axial load capacity = 10 kN

Type of screw – single start square threaded

Permissible tensile stress of screw material = 110 MPa

Permissible tensile stress of body material = 60 MPa

Permissible bearing pressure in threads = 12 MPa

Coefficient of screw friction = 0.12

Coefficient of collar friction = 0.08

Mean diameter of thrust pad = 40 mm

Force applied by operator = 100 N

Neglect bending stresses due to operator force, design the 'C' clamp for following parameters. 16

- standard dimensions of screw
- stresses in screw body at two critical sections
- height of nut
- length of handle.



Design data for square screw threads :

Nominal diameter (mm)	16	18	20	22
Pitch (mm)	3	3	3	3

9. a) A cantilever beam made of cold drawn steel is subjected to a completely reversed load of 1000 N as shown in figure 4 ($s_{ut} = 540 \text{ N/mm}^2$). The notch sensitivity factor q at the fillet can be taken as 0.85 and the expected reliability is 90%. Determine the diameter 'd' of the beam for a life of 10000 cycles. 12

Assume following data :

Surface finish factor = 0.78

Size factor = 0.85

Reliability factor = 0.897

Theoretical stress concentration factor at fillet = 1.35.

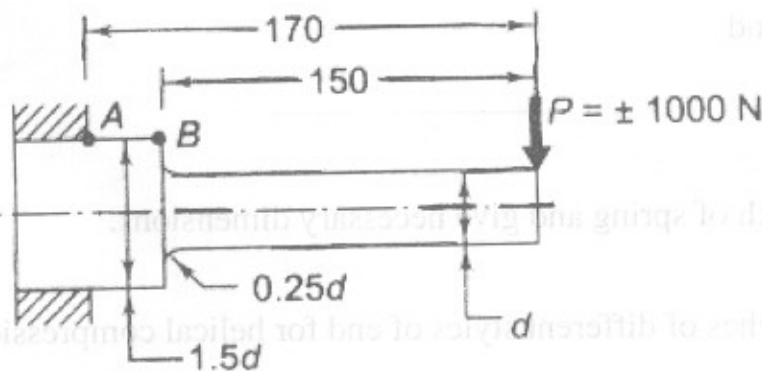


Figure 4

- b) How will you account for stress concentration in design of machine parts. 4

OR



10. Write notes on :

16

- a) S-N curve
- b) Modified Goodman diagram
- c) Miner's equation and its utility
- d) Fatigue failure.

11. a) It is required to design a helical compression spring with plain ends, for carrying a maximum static force of 1000 N. The allowable shear stress and modulus of rigidity for spring material are 400 N/mm^2 and 85 kN/mm^2 respectively. The stiffness of spring is 48 N/mm . If spring index is 5, determine :

- i) wire diameter
- ii) total number of coils
- iii) free length and
- iv) pitch.

Draw neat sketch of spring and give necessary dimensions.

10

b) Draw neat sketches of different styles of end for helical compression spring and illustrate them in short.

8

OR

OR



12. a) A narrow gauge rail car weighing 2000 kg mass and moving at 4.32 km/hr, velocity is brought to rest by a bumper consisting of two helical compression springs of spring index 6. In bringing rail car to rest, both the bumper springs get compressed by 140 mm. The spring steel has permissible sheat stress of 400 N/mm^2 and modulus of rigidity $8.4 \times 10^4 \text{ N/mm}^2$.

Determine :

- i) the maximum load on each spring
- ii) diameter of spring wire
- iii) mean coil diameter
- iv) Number of coils
- v) solid length.

10

b) Explain the construction of multi leaf spring with sketch. What is nipping ? 8

B/I/10/2,200

