

R 8487

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Fifth Semester

Mechanical Engineering

ME 331 — DESIGN OF MACHINE ELEMENTS

Time : Three hours

Maximum : 100 marks

Use of approved Data Book is permitted.

Assume appropriate design data wherever required.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Which failure theory is more suitable to design a component made of
(a) Brittle material (b) Ductile material.
2. Define the following :
(a) Yield strength of the material
(b) Endurance strength of the material.
3. Write the mathematical expression for power transmission by a flat belt drive.
4. The Crank Pin is to be connected in the bush and the dimensions for the bush and Crank-Pin are given respectively in 'mm' are $16^{+0.014}_{+0.000}$, $16^{-0.030}_{-0.051}$. Find the maximum clearance between the bush and Crank Pin.
5. Differentiate Joint (such as cotter joint) and coupling.
6. Define the following with line diagram
(a) Lap Joint
(b) Single V-Butt Weld.
7. What is the purpose of the flywheel in an IC engine?
8. What type of failure occurs in a ball bearing?
9. Differentiate between the variable breadth cantilever spring and uniform breadth cantilever spring in terms of strength.
10. What are the stresses developed in the wire of helical spring?

PART B — (5 × 16 = 80 marks)

Answer either (a) or (b).

11. (a) (i) Explain the following with mathematical expressions.
Maximum distortion energy theory. (4)
Maximum principal stress theory. (4)
- (ii) Determine the diameter of a steel bar, which is of ductile nature subjected to an axial tensile load of 60 kN and torsional moment of 1600 N-m. Use the factor of safety of 2.5, $E = 200 \text{ Gpa}$. (8)

Or

- (b) A cantilever of span 800 mm carries uniformly distributed load of 12 kN/m. The yield value of material of cantilever is 400 MPa. Factor of safety is 2.5. Find economical section of cantilever among
- (i) circular cross section of diameter 'd'.
(ii) rectangular cross section of depth 'd' and width 'w' with $\frac{d}{w} = 2.5$.
(iii) 'T' section of total depth 7t and width 5t where 't' is thickness.

Find the dimension and cross sectional area of the economic section. (16)

12. (a) A hole and shaft have a basic size of 30 mm and to have a clearance fit with maximum clearance of 0.02 mm and a minimum clearance of 0.01 mm. The hole tolerance is to be 1.6 times the shaft tolerance. Determine the limits for both hole and shaft using (i) Hole basis system (ii) Shaft basis system. (16)

Or

- (b) A shaft of 700 mm length is simply supported at its ends. It is subjected to a central concentrated cyclic load that varies from 10 to 30 kN. Determine the diameter of the shaft assuming a factor of safety of 2, size correction factor of 0.8, and surface correction factor of 0.85. The material properties are : ultimate strength = 550 MPa; yield strength = 300 MPa, and endurance limit = 275 MPa. Fatigue stress concentration factor = 1.5. (16)

13. (a) Design a knuckle joint to with stand a tensile load of 60 kN using steel with the following permissible stresses

$$\sigma \text{ (in tension)} = 62.5 \text{ MPa}$$

$$\sigma \text{ (in crushing)} = 75 \text{ MPa}$$

$$\tau \text{ (in shear)} = 50 \text{ MPa.} \quad (16)$$

Or

- (b) (i) A tie bar (A) = 120 mm × 10 mm, welded to another tie bar (B) = 120 mm × 15 mm, is subjected to a load of 120 kN as shown in Fig. 1. Determine the sizes of end fillets such that the stresses in both the fillets are same. Take allowable stress in the weld as 100 MPa. (8)

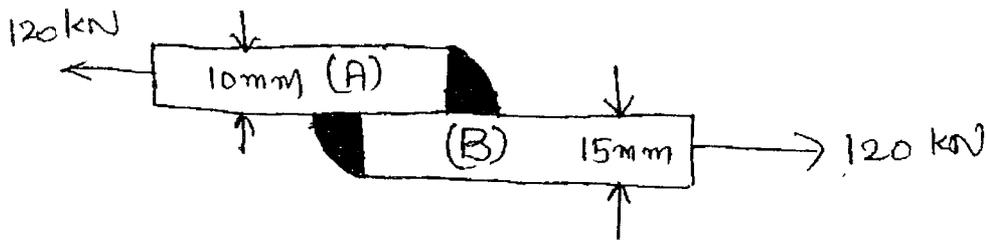


Fig. 1 Problem 13 (b) (i)

- (ii) A welded lap joint is provided to connect two tie bars 150 mm × 10 mm as shown in Fig. 2. The working stress in the tie bar is 120 MPa. Investigate the design, if the size of the fillet is 12 mm. Take working stress in the end fillet as 100 MPa and that in the diagonal fillet as 70 MPa. (8)

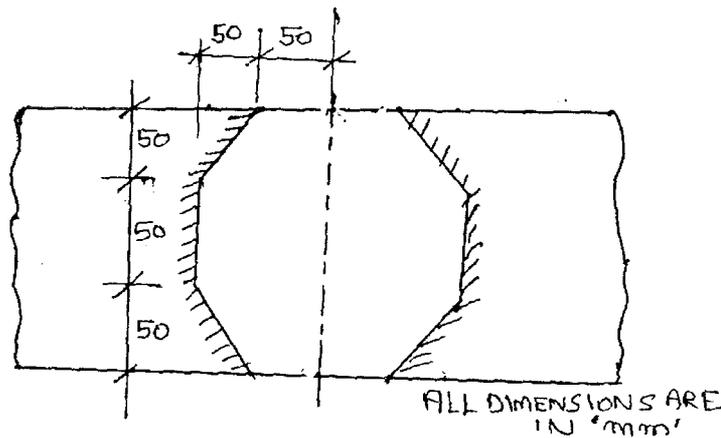


Fig. 2 Problem 13 (b) (ii)

14. (a) Design a connecting rod for an IC engine from the following data.

Piston diameter = 125 mm

Stroke = 150 mm

Length of the connecting rod = 300 mm

Maximum gas pressure is at 5% of the stroke = 5 MPa.

Mass of reciprocating parts = 2 kg

Factor of safety = 5

Material = steel of 35 NiCr 60.

(16)

Or

- (b) Design a cast iron flange coupling to transmit 150 HP at 250 rpm. The following permissible stresses may be used. Permissible shear stress for shaft, bolt and key material = 50 MPa. Permissible crushing stress for bolt and key material = 140 MPa Permissible shear stress for cast iron material = 10 MPa. (16)
15. (a) Design a spring for spring loaded safety valve for the following condition :
- Operating pressure = 1.2 MPa
 - Diameter of the valve seat = 110 mm
 - Design shear stress for the spring = 380 MPa.
 - G = shear modulus = 84 GPa.
- The spring is to be kept in the casing of 130 mm inner diameter and 400 mm long. The spring should be at maximum lift of 6 mm when the pressure is 1.275 MPa. (16)

Or

- (b) Design a leaf spring for a truck to following specifications. (16)
- Maximum load on springs = 160 kN
 - Number of springs = 4; spring material = chromium vanadium steel
 - Permissible tensile stress = 600 MPa
 - Maximum number of leaves = 10
 - Span of the spring = 1300 mm
 - Permissible deflection = 90 mm
 - E for the material = 210 GPa.
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