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**Q 2402**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

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 and state them clearly.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the following :
  - (a) Elastic limit
  - (b) Factor of safety.
2. What is the force required to punch a hole of diameter 'd' in a metal of thickness 't' having ultimate shear strength as ' $\tau_U$ '?
3. Write the mathematical expression for power transmission by a gear drive.
4. Define clearance fit.
5. What is the meaning of M14 × 2 thread?
6. What is purpose of cotter joint?
7. Name the material that is used to make ball bearings.
8. Why 'T'-section connecting rod is designed to satisfy the condition  $I_{XX} < 4I_{YY}$ ?
9. What is purpose of leaf spring that is used in automobiles?
10. What is the spring that is used in a mechanical wrist watch?

PART B — (5 × 16 = 80 marks)

11. (a) A C.I. pulley of 600 mm diameter transmits 30 kW at 300 rpm. The pulley is secured to the shaft by means of key. The material for shaft and key is 30C8 steel. Find diameter  $d$  of shaft and dimensions of key, assuming width of key =  $\frac{d}{4}$ . For 30C8 steel  $\sigma_y$  (Yield strength of material) = 330 MPa,  $\sigma_{UC}$  (Crushing strength of material) = 630 MPa. (16)

Or

- (b) A shaft is subjected to a bending moment varying from -200 N-m to 500 N-m and a twisting moment varying from 50 N-m to 175 N-m. The material 30C8 steel has  $\sigma_U = 600$  MPa,  $\sigma_e = 300$  MPa  $K_a$  (surface finish factor) = 0.76,  $K_b$  (size factor) = 0.85,  $K_c$  (endurance limit correction factor for the type of loading) = 0.897,  $K_t$  (theoretical stress concentration factor) = 1.85, and  $q$  (notch sensitivity index) = 0.95. Find the diameter of the shaft using Hencky and Von-Mises theory. Factor of safety = 1.5. (16)
12. (a) A mild steel bracket as shown in Fig. 1 is subjected to a pull of 6000 N acting at 45° to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60 MPa. (16)

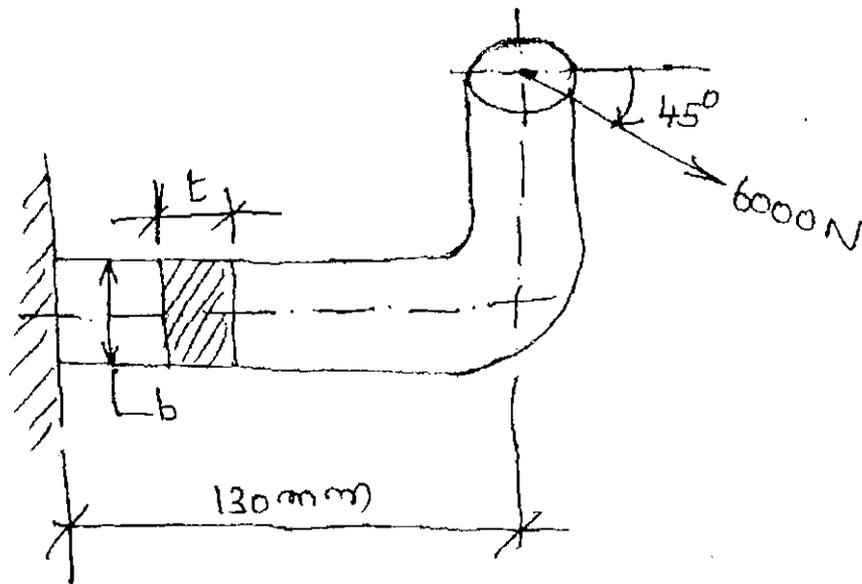


Fig. 1 Qn. 12 (a)

Or

- (b) (i) Define the terms : Fit and tolerance. (4)
- (ii) A hole and shaft have basic size of 32 mm and to have a clearance fit with maximum clearance of 0.022 mm and a minimum clearance of 0.011 mm. The hole tolerance is to be 1.5 times the shaft tolerance. Determine the limits for both hole and shaft using (12)
- (1) Hole basis system (2) Shaft basis system.

13. (a) A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 MPa. The cylinder head is connected by 8 bolts having yield point 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of the bolt required. The stiffness factor for copper gasket may be taken as 0.5. (16)

Or

- (b) Design a knuckle joint to with stand a tensile load of 55 kN using steel with the following permissible stresses.
- $\sigma$  (in tension) = 60 MPa  
 $\sigma$  (in crushing) = 100 MPa  
 $\tau$  (in shear) = 45 MPa.
14. (a) The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multicylinder engine, taken in order from one end are as follows :
- 35, +410, -285, +325, -335, +260, -365, +285, -260 mm<sup>2</sup>. The diagram has been drawn to a scale of 1 mm = 70 N-m and 1 mm = 4.5°. The engine speed is 900 rpm and the fluctuation in speed is not to exceed 2% of the mean speed.
- Find the mass and cross-section of the flywheel rim having 650 mm mean diameter. The density of the material of the flywheel may be taken as 7200 kg/m<sup>3</sup>. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc. (16)

Or

- (b) Design a connecting rod for an IC engine from the following data :
- Piston diameter = 150 mm  
 Stroke = 160 mm, Length of the connecting rod = 320 mm  
 Maximum gas pressure is at 5% of the stroke = 4 MPa  
 Engine speed = 1500 rpm  
 Mass of reciprocating parts = 2.25 kg  
 Factor of safety = 5  
 Material = steel of 35 NiCr 60. (16)

15. (a) (i) Derive the deflection equation for helical spring. (6)
- (ii) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5.
- The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm<sup>2</sup>. (10)

Or

- (b) (i) Design a leaf spring for a truck to following specifications :
- Maximum load on springs = 140 kN, Number of springs = 4; Spring material = chromium vanadium steel; permissible tensile stress = 600 MPa; Maximum number of leaves = 10, Span of the spring = 1000 mm, permissible deflection = 80 mm. E for the material = 200 GPa. (12)
- (ii) Briefly explain “mipping” in leaf spring. (4)