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**Question Paper Code : D 2482**

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2010.

Fifth Semester

Mechanical Engineering

ME 1302 — DESIGN OF MACHINE ELEMENTS

(Regulation 2004)

(Common to B.E. (Part-Time) Fourth Semester – Regulation 2005)

Time : Three hours

Maximum : 100 marks

Use of approved design data book is permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the steps in machine design process?
2. How will you account for stress concentration in design of the machine parts?
3. What is Jack shaft?
4. What is the critical speed of shaft?
5. What is threaded joint?
6. What are the advantages of welded joints compared with riveted joints?
7. What are the applications of concentric spring?
8. Two springs of stiffness  $K_1$  and  $K_2$  are connected in series. What is the stiffness of connection?
9. What is a quill bearing?
10. What is cooling stress?

PART B — (5 × 16 = 80 marks)

11. (a) A shaft, as shown in fig. 11. (a) is subjected to a bending load of 3 kN, pure torque of 1000 N-m and an axial pulling force of 15 kN. Calculate the stresses at A and B.

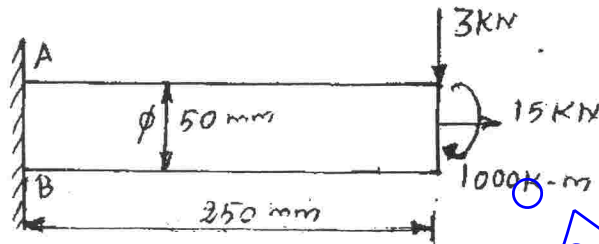


Fig. 11. (a).

Or

- (b) The C-frame of 100 kN capacity press is shown in fig. 11. (b). The material of the frame is grey cast iron and the factor of safety is 3. Determine the dimensions of the frame.

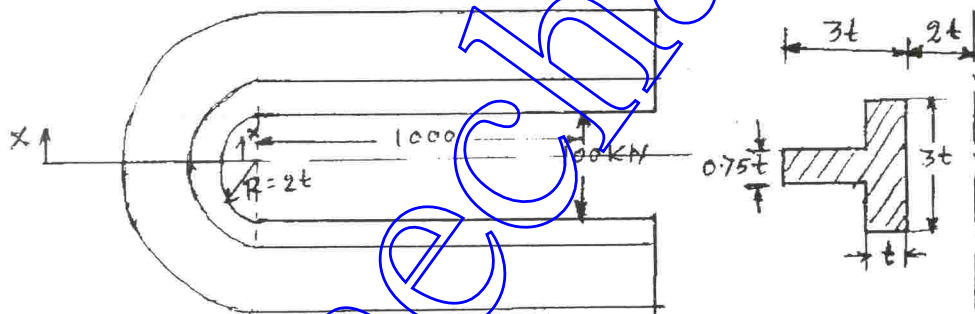


Fig. 11. (b).

All dimension in mm

12. (a) A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is  $180^\circ$  and  $\mu = 0.24$ . Determine the suitable diameter for a solid shaft, allowing working stress of 60 MPa in tension and 40 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.

Or

- (b) Design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50 kN. The rods are co-axial and a small amount of angular movements between their axes is permissible. Design the joint and specify the dimensions of its components. Select suitable materials for the parts.

13. (a) ACME threads are used in a lead screw of a lathe. ACME threads have 50 mm outside diameter and 8 mm pitch. The axial pressure required from lead screw is 2500N. The collar subjected to thrust in the carriage has 110 mm outside diameter and 55 mm inside diameter and the lead screw rotates at 30 r.p.m. Determine,
- The power required to drive the lead screw and
  - The efficiency of the lead screw. Take  $\mu$  for screw as 0.15 and that for collar as 0.12.

Or

- (b) Determine the length of the weld run for a plate of size 120 mm wide and 15 mm thick to be welded to another plate by means of
- A single transverse weld and
  - Double parallel fillet welds when the joint is subjected to variable loads.
14. (a) A concentric spring is used as a valve spring in a heavy duty diesel engine. It consists of two helical compression springs having the same free length and same solid length. The composite spring is subjected to a maximum force of 6000 N and the corresponding deflection is 50 mm. The maximum torsional shear stress induced in each spring is  $800 \text{ N/mm}^2$ . The spring index of each spring is 6. Assume same materials for two springs and the modulus of rigidity of spring materials is  $81370 \text{ N/m}^2$ . The diametral clearance between the coils is equal to the difference between their wire diameters. Calculate :
- The axial force transmitted by each spring.
  - Wire and mean coil diameters of each spring.
  - Number of active coils in each spring.

Or

- (b) A Belleville spring is made of silicon steel. The spring is compressed completely flat when it is subjected to axial force of 4500 N. The corresponding maximum stress is  $1375 \times 10^6 \text{ N/m}^2$ . Assume  $d_o/d_i = 1.75$  and  $h/t = 1.5$ . Calculate :
- Thickness of washer
  - Free height of washer minus thickness(h)
  - Outer diameter of washer and
  - Inner diameter of washer.



15. (a) A single-row deep-groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life  $L_{10th}$  of the bearing is 20,000 hr. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application.

Or

- (b) The turning moment diagram of a multi-cylinder engine is drawn with a scale of (1mm = 1°) on the abscissa and (1 mm = 250 N-m) on the ordinate. The intercepted areas between the torque developed by the engine and the mean resisting torque developed by the engine and the mean resisting torque of the machine, taken in order from one end are -350, +800, -600, +900, -550, +450 and -650 mm<sup>2</sup>. The engine is running at a mean speed of 750 rpm and the coefficient of speed fluctuations is limited to 0.02. A rimmed flywheel made of gray cast iron FG 200 ( $\rho = 7100 \text{ kg/m}^3$ ) is provided. The spokes, hub and shaft are assumed to contribute 10% of the required moment of inertia. The rim has rectangular cross section and the ratio of width to thickness is 1.5. Determine the dimensions of the rim.