C 3301

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fifth Semester

(Regulation 2004)

Mechanical Engineering

ME 1302 — DESIGN OF MACHINE ELEMENTS

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

Time : Three hours Maximum : 100 marks

(Use of PSG Design Data Book is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the common materials used in mechanical engineering Design? How can the properties of steel be improved?

2. List the important factors that influence the magnitude of factor of safety.

3. How is the strength of a shaft affected by the keyway?

4. What is the use of register in a flange coupling?

5. What is throat thickness of a fillet weld?

6. What is the limitation of the single-strap butt joint?

7. What is nipping in a leaf spring? List the materials commonly used for the manufacture of the leaf spring.

8. Why levers are usually tapered?

9. What type of stresses are produced in a disc flywheel?

10. What are the effects of clearance on the performance of a bearing?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A Shaft transmits 20 kW power and rotates at 500 rpm. The material of shaft is 50C4 and the factor of safety is 2.

(1) Determine the diameter of shaft on the basis of its shear strength. (2) Determine the diameter of shaft on the basis of its torsional rigidity, if the permissible angle of twist is 3° per meter length and modulus of rigidity of shaft material is 79300 N/mm². (10)

(ii) A bolt is subjected to a direct load of 25 kN and shear load of 15 kN. Considering various theories of failure, determine a suitable size of the bolt, if the material of the bolt is C 15 having 200 N/mm² yield strength. (6)

Or

(b) A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design. (16)

12. (a) (i) A turbine shaft transmits 500 kW at 900 rpm. The permissible shear stress is 80 N/mm² while twist is limited to 0.5° in a length of 2.5 m. Calculate the diameter of shaft. Take G = 0.8×10^5 N/mm². If the shaft chosen is hollow with d_i / d_o = 0.6. Calculate the percentage of saving in material. (10)

(ii) Design a taper key for a shaft of diameter 75 mm transmitting 45 kW at 225 rpm. The allowable compressive stress as 160 N/mm². (6)

Or

(b) (i) A flexible coupling is used to transmit 15 kW power at 100 rpm. There are six pins and their pitch circle diameter is 200 mm. The effective length of bush, the gap between two flanges and the length of the pin in contact with right hand flange are 35, 5 and 23 mm respectively. The permissible shear and bending stresses in the pin are 35 and 152 N/mm² respectively. Calculate Pin diameter by shear consideration, bending consideration. (6)

(ii) Two rods subjected to a tensile force of 50 kN are connected by means of knuckle joint. Steel 30C8 and the factor of safety is 5. Design the joint and specify the dimensions of its components. (10)

(a) A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover is 1.25 N/mm^2. Calculate the number and the size of studs required to fix the cylinder cover. Assume the permissible stress in the studs to be 70 N/mm^2.

Or

(b) A welded connection shown in fig. 1 is subjected to an eccentric force of 7.5 kN. Determine the size of welds if the permissible shear stress for the weld is 100 N/mm^2. Assume static conditions.

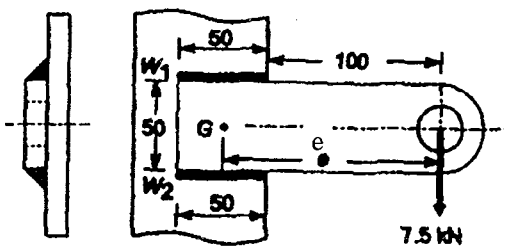

Fig. 1

Note : ALL DIMENSIONS ARE IN 'mm'.

14. (a) A semi elliptical laminated vehicle spring to carry a load of 6000 N is to consist of seven leaves 65 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1 m in length and attached to the axle by two U-bolts 80 mm 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. Design stress for spring material is 350 MPa. Design the spring.

Or

(b) Design a closed coil helical spring for a boiler safety valve which is required to blow off steam at the pressure of 1.5 N/mm^2. The diameter of the valve is 50 mm. The initial compression of the spring is 40 mm and the lift is limited to 20 mm.

15. (a) Design a journal bearing for a centrifugal pump from the following data :

Load on the journal = 20 kN, Speed of the journal = 900 rpm, Type of oil is SAE 10 for which the absolute viscosity at 55°C = 0.017 kg/m-s; Ambient temperature of oil = 15.5°C, Maximum bearing pressure for the pump = 1.5 N/mm^2 Calculate mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited 10°C. Heat dissipation coefficient = 1232 W/m^2/ °C.

Or

(b) A punching machine makes 25 working strokes per minute and is capable of punching 25 mm diameter holes in 18 mm thick steel plate having ultimate shear strength of 300 MPa. The punching operation takes place during 1/10th of a revolution of the crank shaft. Estimate the power needed for the driving motor, assuming mechanical efficiency of 95%. Determine suitable dimensions for the rim cross-section of the flywheel, which is to revolve at 9 times the speed of the crank shaft. The permissible coefficient of fluctuation of speed is 0.1. The diameter of the flywheel must not exceed 1.4 m owing to space restrictions. Check for the centrifugal stress induced in the rim.