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**Question Paper Code : 80917**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fifth/Sixth Semester

Mechanical Engineering

ME 8593 – DESIGN OF MACHINE ELEMENTS

(Common to Automobile Engineering/Industrial Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Approved PSG Design data book is permitted.

Answer ALL questions.

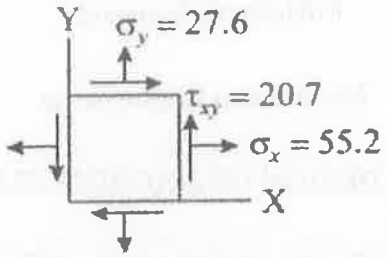
PART A — (10 × 2 = 20 marks)

1. Why the technical specifications are rounded to preferred numbers?
2. What is the fundamental concept of von Mises failure theory?
3. Compare flexural and torsional rigidities of shaft.
4. List the advantage of flexible coupling over rigid coupling.
5. Define cohesive and adhesive failures of bonded joints.
6. When 2 mm thick sheet metals are to be joined together for leak proof. Suggest suitable jointing method(s) for this.
7. "Flywheel is a energy storage device". Justify the statement.
8. State the failure modes of connecting rod.
9. Define bearing modulus.
10. Differentiate static and dynamic capacities of rolling contact bearings.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Elaborate factors affecting the selection of materials. (5)

(ii) At a point in the structural member, the stresses (in MPa) are represented as in Figure. Determine : (1) the magnitude and orientation of the principal stresses (2) the magnitude and orientation of the maximum shearing stresses and associated normal stresses. (8)

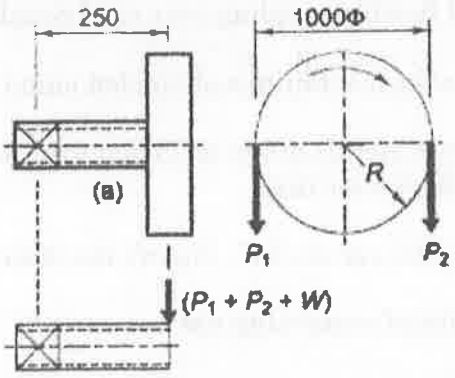



Or

(b) (i) An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 square mm in section. If the maximum instantaneous extension is known to be 1.5 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 GPa. (7)

(ii) A rectangular plate 1 m (length) × 60 mm (width) × 12 mm (thick) having central hole of 10 mm diameter is subject to a axial load of 12 kN. Determine maximum stress induced due to stress concentration. (6)

12. (a) A hollow transmission shaft, having inside diameter 0.6 times the outside diameter, is made of plain carbon steel 40C8 (yield stress = 380 N/sq.mm) and the factor of safety is 3. A belt pulley, 1000 mm in diameter, is mounted on the shaft, which overhangs the left hand bearing by 250 mm. The belts are vertical and transmit power to the machine shaft below the pulley. The tension on the tight and slack sides of the belt are 3 kN and 1 kN respectively, while the weight of the pulley is 500 N. The angle of wrap of the belt on the pulley is 180°. Calculate the outside and inside diameters of the shaft. (13)




Or

(b) Design a rigid flange coupling to transmit a power of 15 kW at 600 rpm between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are Given below :

Shear stress on shaft = 100 MPa

Bearing or crushing stress on shaft = 250 MPa

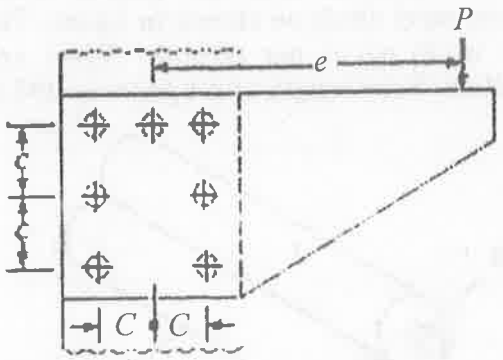
Shear stress on keys = 100 MPa

Bearing stress on keys = 250 MPa

Shearing stress on cast iron = 200 MPa

Shear stress on bolts = 100 MPa (13)

13. (a) An eccentrically loaded lap riveted joint is to be designed for a steel bracket as shown in Fig. The bracket plate is 25 mm thick. All rivets are to be of the same size. Load on the bracket, P = 40 kN ; rivet spacing, C = 100 mm; load arm, e = 0.5 m. Permissible shear stress is 60 MPa and crushing stress is 100 MPa. Determine the size of the rivets to be used for the joint. (13)




Or

(b) Design a knuckle joint to transmit axial load of 140 kN. The design stresses may be taken as 70 MPa in tension, 60 MPa in shear and 140 MPa in compression. (13)

14. (a) Design a cast iron flywheel to store 70 KNm of energy to maintain the speed variation between 300±7 rpm. The maximum outer radius of the fly wheel is 0.8 m. Machine which is connected with the flywheel produces maximum power of 18 kW. Take maximum torque = 1.5 times the mean torque. Also design the rim and arms if the flywheel. (13)

Or

(b) Design a close coiled helical compression spring for a service load ranging from 2000 N to 2500 N. The axial deflection of the spring for the load range is 5.5 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 GPa. Neglect the effect of stress concentration. (13)

15. (a) A belt driven shaft can have journal diameter d vary from 25 to 30 mm. The radial load = 4000 N while axial load = 1000 N. The bearing is required to last for 1500 hours at 350 rpm, check the suitability of the bearing for the following bearing SKF 6305 and SKF 6406. (13)

Or

(b) Following data are given for a 360° hydrodynamic bearing : (13)

Radial load = 3.2 kN

Journal speed = 1400 r.p.m.

Journal diameter = 50 mm

Bearing length = 50 mm

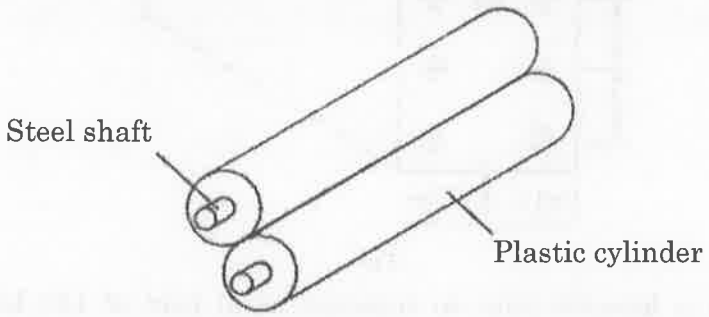
Radial clearance = 0.04 mm

Viscosity of the lubricant = 30 cP

Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, Then calculate : (i) Power lost in friction, (ii) coefficient of friction, (iii) Minimum oil film thickness, (iv) Flow requirement in liters/min; and Temperature rise.

PART C — (1 × 15 = 15 marks)

16. (a) The paper feed for a photocopier is controlled by two rollers that are sprung together with a force of approximately 20 N. The rollers each consist of a 20-mm-outer-diameter plastic cylinder pressed onto a 10-mm-diameter steel shaft as shown in figure. The maximum feed rate for the copier is 30 pages per minute. Select and design bearings to support the rollers. Take length of A4 paper is 297 mm. (15)




Or

(b) Determine the optimum overlap for a simple lap joint for 1.6 mm sheet metal if the maximum load is 250 N/mm wide. Use the Araldite for which data are given in Figure. (15)