Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30924

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 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

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the steps involved in design process?

2. State the assumptions that are made in the stress analysis of curved beams.

3. Where do you use splines? What are the different types of spline profile?

4. What are the advantages of Woodruff keys?

5. List out the applications of knuckle joint.

6. State fillet weld.

7. What type of stresses are induced in rimmed flywheel?

8. Which crank position are considered while designing an centre crank shaft?

9. What is Sommer field number? What is its importance?

10. Differentiate between hydrostatic and hydro dynamic bearings.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Write briefly about general consideration of machine design. (5+8)

(ii) A rod of a linkage mechanism made of steel 40 Cr 1 (Sut = 550 N/mm²) is subjected to a completely reversed axial load of 100 kN. The rod is machined on a lathe and the expected reliability is 95%. There is no stress concentration. Determine the diameter of the rod using a factor of safety of 2 for an infinite life condition.

Or

(b) (i) State Distortion energy theory. Where do you use this theory? (6+7)

(ii) A hub is press fitted on a shaft. An element of the hub is subjected to a radial compressive stress of 50 MPa and hoop stress of 75 MPa. Find the factor of safety if hub is made of 30 C8 steel with S_y = 350 MPa.

12. (a) A hollow transmission shaft, having inside diameter 0.6 times the outside diameter, is made of plain carbon steel 40C8 (S_{yt} = 380 N/mm²) and the factor oil 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 tensions 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) A rigid coupling is used to transmit 50 kW power at 300 rpm. There are six bolts. The outer diameter of the flanges is 200 mm, while the recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm²) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes. (13)

13. (a) It is required to 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 movement between their axes is permissible. Design the joint and specify the dimensions of its components. Select suitable materials for the parts. (13)

Or

(b) (i) What are the advantages of riveted joint over welded joints? (4)

(ii) How much length of a 10 mm fillet weld is required to weld the long side of ISA angle 150 × 75 × 10 to a steel plate with side welds only? A static load of 125 kN acts through the centre of gravity of the angle section which is 53.2 mm from the short side. The allowable load per mm of the weld length is 665 N. (9)

14. (a) A helical spring of mean coil diameter of 110 mm is to be designed to match semi-elliptical leaf spring with ten leaves in all, out of which two are full length leaves extending 600 mm. The leat spring is 60 mm wide and is small of strips 6 m thick. Both helical spring and leaf spring should have same values of induced stress and deflection for all loads. Calculate wire dia, outside dia, no of active boils Assume E/G = 2.5.

Or

(b) A rimmed flywheel made of grey cast iron FG 200 $\left(\rho = 7100\, kg/m^3\right)$ is required to keep down fluctuations in speed from 200 to 220 rpm. The cyclic fluctuations in energy is 30,000 N-m , while the maximum torque during the cycle is 75,000 N-m. The outside diameter of the fly wheel should not exceed 2 m. It can be assumed that there are six spokes and the rim contributes 90% of the required moment of inertia. The cross - section of the rim is rectangular and the ratio of width to thickness is 2. Determine the dimensions of the rim. Assuming suitable cross-section for spokes, calculate the stresses in the rim and the spokes using Timoshenko's expressions. (13)

15. (a) (i) Explain the selection of bearing from manufactures catalogue. (7)

(ii) List out the desirable properties of a good bearing material. (6)

Or

(b) (i) What is bearing characteristics number? Discuss its relation with co-efficient of friction. (4)

(ii) A ball bearing is operating on a work cycle consisting of three parts -a radial load of 3000 N at 1440 rpm for one quarter cycle, a radial load of 5000 N at 720 rpm for one half cycle, and radial load of 2500 N at 1440 rpm for the remaining cycle. The expected life of the bearing is 10,000 h. Calculate the dynamic load carrying capacity of the bearing. (9)

PART C — (1 × 15 = 15 marks)

Q. No. 16 is compulsory.

16. (a) Design a connecting rod for an internal combustion petrol engine with piston diameter 110 mm, mass of reciprocating parts 2 kg, length of the connecting rod is 325 mm, stroke is 150 mm, speed 1500 rpm with possible over speed upto 2500 rpm. It compression ratio 4:1 and maximum explosive pressure is 2.5 MPa. (15)

Or

(b) (i) Select suitable materials for the following parts for the special property which makes it more suitable use in manufacturing. (8)

(1) Ball bearing

(2) Helical springs

(3) Keyway.

(ii) Discuss the reasons why the size of multi cylinder engine flywheel size is smaller than that of single cylinder engine. (7)

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