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Question Paper Code : 80848

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2021.

Fifth Semester

Mechanical Engineering

ME 2303/10122 ME 504/ME 53 — DESIGN OF MACHINE ELEMENTS

(Common to Manufacturing Engineering, Automobile Engineering, Industrial Engineering, Industrial Engineering and Management and Mechanical and Automation Engineering)

(Regulations 2008 / 2010)

(Also common to PTME 2303/PTME 3214 for B.E. (Part-Time) Fourth Semester – Mechanical Engineering – Regulations 2009)

Time : Three hours Maximum : 100 marks

Note : Approved Design Data Book is permitted to use in the examination.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Describe the material properties of hardness, stiffness and resilience.

2. What are the methods used to improve fatigue strength?

3. What is the difference between spindle and axle?

4. How the length and diameter of a shaft affects its critical speed?

5. What is preloading of bolts?

6. State the advantages of the welded joints.

7. What is stiffness of spring?

8. What is nipping of leaf spring?

9. What situations demand the use of needle roller bearings?

10. What is the limitation of Mckees equation?

PART B — ($5 \times 16 = 80$ marks)

11. (a) A machine part is statically loaded and has an yield point strength of350 N/mm^2. If the principal stresses are 70 N/mm^2 and 35 N/mm^2, both tensile find the factor of safety for the following cases.

(i) Maximum normal stress theory

(ii) Maximum shear stress theory and

(iii) Distortion energy theory.

Or

(b) An unknown weight falls through 10 mm on to a collar which is rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 cross section. The maximum instantaneous extension is 2 mm. What is the corresponding stress and the value of the weight. Take E = 200 kN/mm^2.

12. (a) A hoisting drum 0.5 m in diameter is keyed to a shaft which is supported in two bearings and driven through a 12:1 reduction ratio by an electric motor. Determine the power of the driving motor, if the maximum load of 8 kN is hoisted at a speed of 50 m/min and the efficiency of the drive is 80%. Also determine the torque on the drum shaft and the speed of the motor in r.p.m. Determine also the diameter of the shaft made of machinery steel, the working stresses of which are 115 MPa in tension and 50 MPa in shear. The drive gear whose diameter is 450 mm is mounted at the end of the shaft such that it overhangs the nearest bearing by 150 mm. The combined shock and fatigue factors for bending and torsion may be taken as 2 and 1.5 respectively. (16)

Or

(b) Design a rigid flange coupling to transmit a torque of 250 Nm between co-axial 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
Shearing stress on bolts	=	100 MPa

After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. The stresses developed in the various members may be checked if thumb rules are using for fixing the dimensions. (16)

13. (a) A flanged bearing is fastened to a frame by means of four bolts, spaced equally on 500 mm bolt circle. A 250 kN force acts at a distance of 200 mm from the frame. Flange diameter is 600 mm. The tensile stress in the bolts is not to exceed 80 N/mm^2. Determine the size of the bolt.

Or

(b) Determine the length of welds required to transmit a load of 54.5 kN between 12.7 mm thick plates, when the plates are to be joined by

(i) two parallel fillet welds

(ii) two transverse fillet welds.

Also solve this problem for fatigue loading.

14. (a) A helical spring is made from a wire of 8 mm diameter and is of outside diameter 75 mm. The spring has 6 numbers of active coils. If the permissible stress in shear is 350 N/mm2 and the modulus of rigidity is 84 kN/mm^2. Find the axial load, which the spring can take and the deflection produced.

Or

(b) A cast iron flywheel for a blanking press has a mean diameter of 1.5m. The normal operating speed of 275 rpm slows down to 250 rpm during the punching operation. The required energy Fluctuation is 6500 joules and the density of the cast iron is 7000 kg/m^3. Find the area of flywheel rim if the arms and hub provide 7% of the flywheel effect.

15. (a) Design a helical compression spring to sustain an axial load of 4 kN. The deflection is 80 mm. Spring index is 6. The shear is not exceed 350 MPa. Rigidity modulus for spring material is 81 GPa. (16)

Or

(b) Design a leaf spring the following specifications for a truck. Assume FOS = 2.

No. of springs = 4
Maximum load on springs = 100 kN
Material of springs = Cr Va steel (σ_u = 1380 MPa and $E = 206 \times 10^3$ MPa)
Span of spring = 1000 mm
Width of central band = 150 mm
Permissible deflection = 100 mm
Assume 2 full leaves and 6 graduated leaves. (16)