4-6 AN

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

Question Paper Code : 57566

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Mechanical Engineering

ME 6503 – DESIGN OF MACHINE ELEMENTS

(Regulations 2013)

(Common to B.E. Automobile Engineering, Mechanical and Automation Engineering, Industrial Engineering and Mechatronics Engineering)

Time : Three Hours **Maximum : 100 Marks**

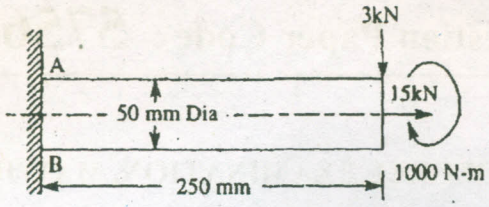
Note : Use of Approved Design Data Book is permitted.
Any required design data can be suitably assumed
Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Describe the material properties of hardness, stiffness and resilience.
2. Define stress concentration.
3. What is the effect of key ways cut into the shaft ?
4. Differentiate between rigid coupling and flexible coupling.
5. What are the stresses act on screw fastenings due to static loading ?
6. What are the two types of fillet weld ?
7. Define spring rate.
8. Define the term 'fluctuation of speed' and 'fluctuation of energy'.
9. What is meant by hydrodynamic lubrication ?
10. What are the advantages of Rolling Contact Bearings over Sliding Contact Bearings ?

PART – B (5 × 16 = 80 Marks)

11. (a) A shaft, as shown in Fig, is subjected to a bending load of 3 kN, pure torque of 1000 N-m and a'n axial pulling force of 15 kN. Calculate the stresses at A and B. (16)



All dimensions in mm.

OR

(b) A steel cantilever is 200 mm long. It is subjected to an axial load which varies from 150 N (compression) to 450 N(tension) and also a transverse load at its free end which varies from 80 N up to 120 N down. The cantilever is of circular cross-section. It is of diameter 2d for the first 50mm and of diameter'd' for the remaining length. Determine its diameter taking a factor of safety of 2. Assume the following values:

Yield stress = 330Mpa; Endurance limit in reversed loading = 300Mpa

Correction factors = 0.7 in reversed axial Loading

= 1.0 in reversed Bending

Stress concentration factor = 1.44 for bending

= 1.64 for axial loading

Size effect factor = 0.85; Surface effect factor = 0.90;

Notch sensitivity index = 0.90 (16)

12. (a) A solid steel shaft is supported on two bearings 1.8 m apart and rotates at 250 r.p.m. A 20° involute gear D, 300 mm diameter is keyed to the shaft at a distance of 150 mm to the left on the right hand bearing. Two pulleys B and C are located on the shaft at distances of 600 mm and 1350 mm respectively to the right of the.left hand bearing. The diameters of the pulleys B and C are 750 mm and 600 mm respectively. 30 kW is supplied to the gear, out of which 18.75 kW is taken off at the pulley C and 11.25 kW from pulley B. The drive from B is vertically downward while from C the drive is downward at an angle of 60° to the horizontal. In both cases the belt tension ratio is 2 and the angle of lap is 180°. The combined fatigue and shock factors for torsion and bending may be taken as 1.5 and 2 respectively. Design a suitable shaft taking working stress to be 42 MPa in shear and 84 MPa in tension. (16)

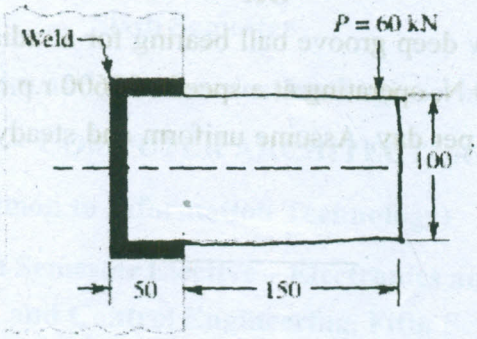
OR

(b) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa. (16)

13. (a) A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 N/mm^2. The cylinder head is connected by 8 bolts having yield point 330 MPa and Endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5 . **(16)**

OR

(b) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in Fig. Determine the weld size if shear stress in the same is not to exceed 140 MPa. **(16)**



14. (a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm^2. It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The . modulus of rigidity for the spring material is 80 kN/mm^2.

Calculate: 1. Diameter of the spring wire, 2. Mean coil diameter,

3. Number of active turns, and 4. Pitch of the coil. **(16)**

OR

(b) A punching press pierces 35 holes per minute in a plate using 10kN-m of energy per hole during each revolution. Each piercing takes 40 per cent of the time needed to make one revolution. The punch receives power through a gear reduction unit which in turn is fed by a motor driven belt pulley 800 mm diameter and turning at 210 r.p.m. Find the power of the electric motor if overall efficiency of the transmission unit is 80 per cent. Design a cast iron flywheel to be used with the punching machine for a coefficient of steadiness of 5, if the space considerations limit the maximum diameter to 1.3 m.

Allowable shear stress in the shaft material = 50 MPa,

Allowable tensile stress of cast iron= 4 MPa,

Density of cast iron = 7200 kg/m^3. **(16)**

15. (a) Design a journal bearing for a centrifugal pump from the following data : Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE JO, for which the absolute viscosity at 55°O 0.017 kg/m-s; Ambient temperature of oil = 15.5°C; Maximum bearing pressure for the pump = 1.5 N/mm2. Take the diameter of the journal as 100 mm and length to diameter ratio as 1.6.Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m2/°C. **(16)**

OR

(b) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. Take 300 working days per year. **(16)**

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