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Question Paper Code : 13051

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Fifth Semester

Mechanical Engineering

080120025 — DESIGN OF MACHINE ELEMENTS

(Common to Automobile Engineering)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

(Use of PSG Design Data book is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List the various steps involved in the design of a machine element.

2. Compare the characteristics of Gerber curve Soderberg and Goodman lines.

3. Classify keys with its applications.

4. Write the advantages of the knuckle joints.

5. List the advantages and disadvantages of a threaded joint.

6. Define efficiency of a riveted joint.

7. What is the objective of the nipping of the leaf spring?

8. Write the advantages of Belleville spring.

9. What is the limitation of Mckee's equation?

10. Distinguish between hydrostatic and hydrodynamic bearings.

PART B — (5 × 16 = 80 marks)

11. (a) The dimensions of an overhang crank are given in figure 11(a). The force P acting at the crank pin is 1 kN. The crank is made of steel 30C8 and factor of safety is 2. Using maximum shear stress theory of failure, determine the diameter'd' at the section XX

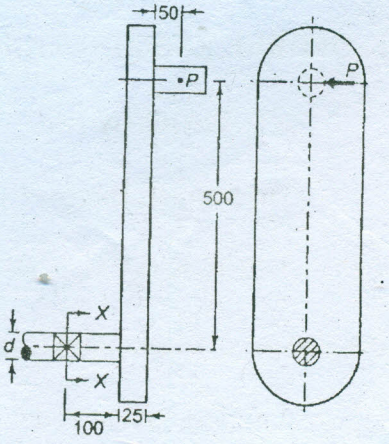

Fig.11(a)

Or

(b) A pulley is keyed to a shaft midway between two anti friction bearings. The bending moment at the pulley varies from -170 N m to 510 N m as the torsional moment in the shaft varies from 55 N m to 165 N m. The frequency of the variation of the loads is the same as the shaft speed. The shaft is made of cold drawn steel having an ultimate strength of 538 MPa and yield strength of 400 MPa. Determine the required diameter for an infinite life. The stress concentration factor for the keyway in bending and torsion may be taken as 1.6 and 1.3 respectively. Use design factor N = 1.5.

12. (a) A hollow transmission shaft, having inside diameter 0.6 times the outside diameter is made of plain carbon steel 40C8 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 is 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 diameter of the shaft.

Or

(b) Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8. The sleeve is made of grey cast iron FG 200. The factor of safety of the shaft and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength.

13. (a) A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B, as shown in figure. Assuming that the bracket is held against the wall and prevented from tipping about the point by all four bolts and using an allowable tensile stress in the bolts as 345 N/ mm^2, determine the size of the bolts on the basis of maximum principal stress theory.

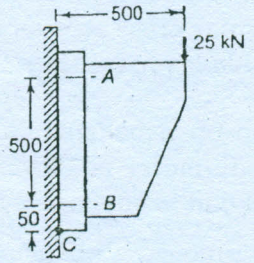

Fig.13(a)

Or

(b) A circular beam, 50 mm in diameter is welded to a support by means of a fillet weld as shown in figure. Determine the size of the weld, if permissible shear stress in the weld is limited to 100 N/mm^2.

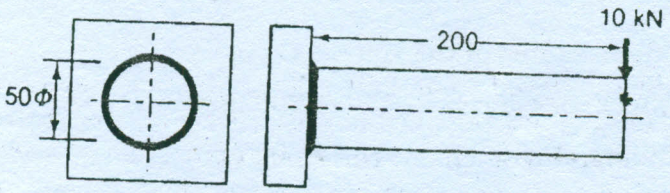

Fig.13(b)

14. (a) A helical compression spring is used to absorb the shock. The initial compression of the spring is 30 mm and it is further compressed by 50 mm while absorbing the shock. The spring is to absorb 250 J of energy during the process. The spring index can be taken as 6. The spring is made up of patented and cold drawn steel wire with an ultimate tensile strength of 1500 N/mm^2 and modulus of rigidity of 81 kN/mm^2.The permissible shear stress for the spring wire should be taken us 30 % of the ultimate tensile strength. Design the spring and calculate:

(i) Wire diameter

(ii) Mean coil diameter

(iii) Number of active turns

(iv) Free length &

(v) Pitch of the turns.

Or

(b) The lever loaded safety valve is mounted on the boiler to blow off at a pressure of 1.5 MPa gauge. The effective diameter of the opening of the valve is 50 mm. The distance between the fulcrum and the dead weights on the lever is 1000 mm. The distance between the fulcrum and the pin connecting the valve spindle to the lever is 100 mm. The lever and the pin are made of plain carbon steel 30C8 and the factor of safety is 5. The permissible bearing pressure at the pins in the lever is 25 N/mm^2. The lever has a rectangular cross section and the ratio of width to thickness is 3:1. Design a suitable lever for the safety valve.

15. (a) The radial reaction on a bearing is 8000 N. It also carries a thrust of 5000 N. The shaft diameter is 140mm and it rotates at 1700 rpm. Outer ring is stationery. Load is smooth, 8 hours/day for a life of 17000 hours.

(i) Select a deep groove ball bearing.

(ii) What is the rated 90 % life of the selected bearing?

(iii) For b = 1.34 compute the probability of the selected bearing surviving 17000 hours.

Or

(b) The following data is given for a rimmed flywheel made of grey cast iron FG 200:

Mean radius of the rim = 1.5 m

Thickness of rim = 200 mm

Width of rim = 300 mm

Number of spokes = 6

Cross sectional area of the each spoke = 10000 mm^2

Speed of rotation = 720 rpm

Calculate:

(i) The tensile stress in rim at = 30° and = 0°

(ii) The axial stress in each spoke

(iii) The mass density of cast iron FG 200 is 7100 kg/m^3