P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)
Sixth Semester, B.E. - Automobile Engineering
Semester End Examination; June - 2017
Design of Machine Elements - II

Time: 3 hrs   *Max. Marks: 100*

Note*: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. What is curved beam? Differentiate between curved and straight beam. Give practical examples of machine components made of curved beam. — 5

   b. A crane hook of trapezoidal cross section of dimensions ½(120+60)×90 mm has an inner radius of curvature of 120 mm. The load line is 15 mm away from the centre of curvature. Determine the safe load that the hook can carry, if it is made of steel having an allowable stress of 90 MPa. — 15

2 a. Explain the following :

   i) Surge in spring's   ii) Equalized stresses in leaf spring. — 7

   b. The valve spring of a gasoline engine is 40 mm long, when the valve opens and 50 mm long when the valve is closed. The spring loads are 360 N when the valve is closed and 540 N when the valve is open. The inside diameter of coil cannot be less than 30 mm. Design the spring. Select C_r - V_a steel for spring and f.o.s = 3. — 13

UNIT - II

3 a. Derive the Lewi's equation for a spur gear and state the assumptions made. — 8

   b. Determine the module, face width, pitch diameters of the spur gear drive from the stand point of strength for the following specifications :

   Power to be transmitted : 35 kW, Speed of piston = 750 rpm, velocity ratio = 3.5:1, Tooth profile = 20° FDI, pinion material in steel with allowable static stress of 110 N/mm^2, gear material is CI with allowable static stress of 60 N/mm^2, the number of teeth on pinion = 16, face width = 12 times module. — 12

4 a. Define :

   i) Normal pitch   ii) Axial pitch   iii) Virtual number of teeth, relating to helical gears. — 4

   b. Pair of helical gears is to transmit 15 kW. The teeth are 20° FDI in normal plane and have a helix angle of 30°. The pinion has 24 teeth and operates at 10000 rpm. The velocity ratio is 5:1. The pinion is made of cast steel (σ_d = 50 MPa) and the gear is of bronze (σ_d = 40 MPa). The pinion material is hardened to 200 BHN. Design a pair of helical gears for strength. Check for dynamic and wear load. — 16

UNIT - III

5 a. For the Bevel gears, define the following :

   i) Cone distance   ii) Pitch angle   6

   iii) Face angle   iv) Back cone distance.

   b. A pair of 20° full depth involute teeth bevel gears are to be designed to connect two shafts at right angles having velocity ratio 4:1. The gear is made of cast steel 0.2% untreated and the pinion material is of C30 steel, heat treated. The pinion has 20 teeth and transmits 40 kW at 720 rpm. Design the gears completely.   14

6 a. Define the following terms used in worm gearing :   4

   i) Lead   ii) Lead angle   iii) Helix angle.

   b. A worm gear type is required to transmit 15 kW at 500 rpm of the worm. The velocity ratio is 25:1. The centre distance should be around 500 rpm. Design the worm gear train. The material of the gear is phosphor bronze and that of the worm is hardened steel. Determine also the efficiency of the drive.   16

UNIT - IV

7 a. Establish an expression for the frictional torque transmitted by a single plate clutch.   7

   b. Design a cone clutch to transmit 7.5 kW at 900 rpm. The face angle is 12.5°. The cone face is lined with leather and the normal pressure between contact faces is not to exceed 0.9 MN/m^2 and coefficient of friction is 0.2. Determine the main dimension of the clutch and axial force required to engage the clutch.   13

8 a. Discuss the classification of brakes.   5

   b. What is self energizing brake? When a brake becomes self locking?   5

   c. A single block brake with drum diameter of 350 mm is show in Fig. 1. The angle of contact is 90°, coefficient of friction is 0.33. Determine the safe power that can be absorbed at 1440 rpm.

Fig.1   10
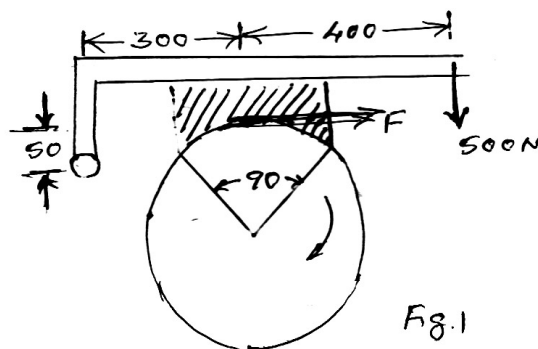
UNIT - V

9 a. What are rolling contact bearings? What are their advantages over journal bearings?   4

   b. How do you express the life of a bearing? What is an average or median life?   4

c. A ball bearing is to be used on a shaft of diameter 30 mm running at 400 rpm. The loads are found to be 2000 N radical and 2000 N thrust. The bearing is to have a life of 3000 hours at a reliability of 94%. Select a suitable bearing.   12

10 a. Explain wedge film lubrication. How is it different from squeeze film lubrication?   4

b. What are the possible ways to restore the stable operating condition in a hydrodynamic journal bearing? When it encounters the higher magnitude of loads?   4

c. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at a shaft speed of 1800 rpm. Assume ratio of diameter to diameter clearance of 1000. The viscosity of oil is 0.01 pas at the operating temperature. Determine:

i) Somerfield's number

ii) Coefficient of friction based on McKee's equation

iii) Amount of heat generated.   12

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