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; May / June - 2019
Design of Machine Elements - II

Time: 3 hrs   *Max. Marks: 100*

Note: *i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) DHB is permitted   iii) Missing data, if any, may be suitably assumed.

UNIT - I

1 a. Derive an expression for stresses at inner and outer fibre in curved beams (Winkler-Bach equation).   8

b. Calculate the stresses at the points *A* and *B* for a circular beam as shown in Figure: 1(b). The circular beam is subjected to compressive load of 6 kN.   12
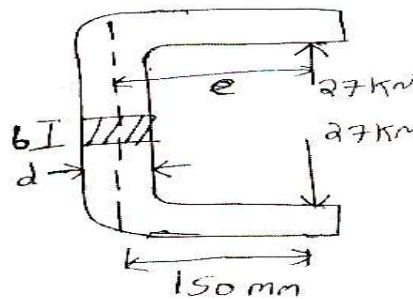

Figure: 1(b)

2 a. Define Spring and briefly explain the following terms with neat sketch :
   i) Helical coil spring   ii) Leaf spring   6

b. A carriage weighing 25000 N is moving on a track with a linear velocity of 3.6 km/hr. It is brought to rest by helical compression springs in the form of a bumper by undergoing a compression of 180 mm. The springs may be assumed to have a spring index of 6 and permissible shear strength of 450 MPa. Design the spring. Take modulus of rigidity as 81.4 GPa.   14

UNIT - II

3 a. Derive Lewis equation.   8

b. Determine Module, Face width and Pitch circle diameter of a spur gear drive to transmit 55 kW at 800 rpm of the pinion. The speed ratio is 3:2:1. Assume the number of teeth on pinion to be 20 and 20º full depth involute tooth profile. Both pinion and gear are made up of cast steel 0.20%C heat treated (σ_d = 193.2 MPa and BHN = 250). Take service factor as 1.   12

4 a. Write the advantages and disadvantages of Helical gear over spur gear.   6

b. A compressor running at 350 rpm is driven by a 120 kW motor running at 1400 rpm. The centre distance is 400 mm and helix angle is 25°. The motor pinion is made of forged steel (σ_{d1} = 220 MPa and BHN$_1$ = 200) and driven gear is cast steel (σ_{d2} = 193.2 MPa and BHN$_2$ = 250). Design the gear using 20° full depth involute tooth profile. Take number of teeth on pinion as 20, wear and lubrication factor as 1.15, load stress factor K = 0.2537 and C = 441.84 N/mm.   14

UNIT - III

5. Design a pair of bevel gears to connect two shafts at 600. The power transmitted is 25 kW at 900 rpm of pinion. The seed ratio is 5:1. The teeth are 20° full depths involute and pinion has 24 teeth. Both pinion and gear are made for forged steel 0.30%C heat treated (σ_d = 220 MPa and BHN = 200). Take service factor as 1 and C = 812.6 N/mm.   20

6 a. Briefly explain the following terms in Worm gears :   6

   i) Axial or Linear pitch   ii) Lead   iii) Lead angle

   b. A triple threaded worm has teeth of 6 mm module and pitch circle diameter of 50 mm. If the worm gear has 30 teeth of 14½° involute and coefficient of friction of the worm gearing is 0.05, find;   14

   i) Lead   ii) Lead angle of the worm   iii) Velocity ratio   iv) Centre distance   v) Efficiency

UNIT - IV

7 a. Establish an expression for the torque transmitted by a multi plate clutch by considering uniform pressure theory.   10

   b. A cone clutch with face angle 14° has to transmit 286 N-m of torque at a speed of 600 rpm. The larger diameter of the clutch is 250 mm, face with width is 60 mm and coefficient of friction is 0.18. Assuming uniform wear conditions, determine;

   i) Axial force required to transmit the torque   10

   ii) Average normal pressure

   iii) Maximum pressure

8 a. Define brake and write any four differences between Block brake and Band brake.   6

   b. Determine the torque required for the block brake shown in Figure: 8(b). Take coefficient friction μ = 0.3
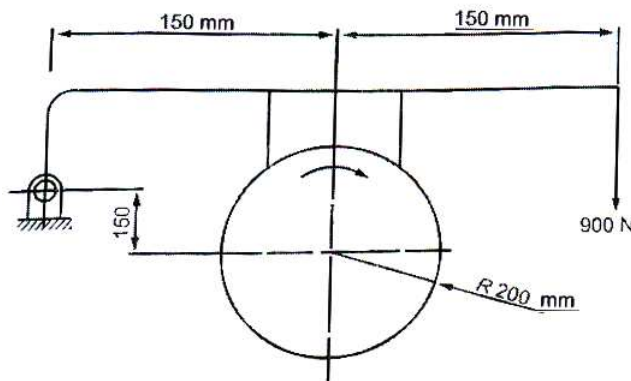

Figure: 8(b)   all dimensions are in mm   6

   c. A simple band brake as shown in Figure: 8(c) is to absorb a power of 30 kW at a rated speed of 750 rpm. Determine;

   i) The effort required to stop clockwise rotation of the brake drum   8

   ii) The effort required to stop counter clockwise rotation of the brake drum

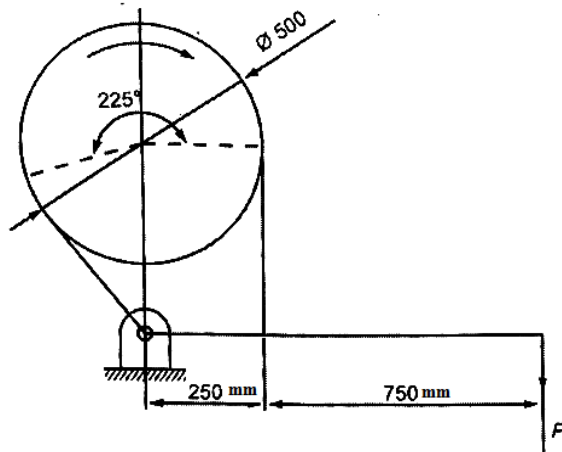   iii) The dimensions of cross section of the Bank assuming its width to be ten times the thickness

Figure: 8(c)   all dimensions are in mm

UNIT - V

9 a. Write a short note on :   8

  i) Bearing materials   ii) Lubricants   iii) Hydro dynamic lubrication

  b. An 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a clearance of 0.05 mm and the viscosity of oil is 0.021 kg/m-s at the operating temperature of the bearing is cable of dissipating 80 j/s. Assuming full journal bearing condition. i.e., $\beta = 360°$. Determine the maximum safe speed and velocity.   12

10 a. List any six types of antifriction bearings and briefly explain any two with neat sketch.   8

  b. A single row deep groove ball bearing has a specific dynamic capacity of 46.3 kN. The actual radial load $F_r = 9$ kN. The speed of rotation is 1800 rpm. What is the life in;

  i) Cycle of operation   12

  ii) In Hours

  iii) What is the average life

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