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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCDM2 / 16ME5DCDM2 **Max Marks: 100**
Course: Design of Machine Elements-2

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Design Data handbook is permitted.

UNIT - I

1. a) Derive the equation of bending for a curved beam, stating the assumptions. **08**

   b) Consider a crane hook made from a 50 mm diameter bar and loaded as shown in figure Q1(b). Determine the maximum tensile stress and specify its location. **12**

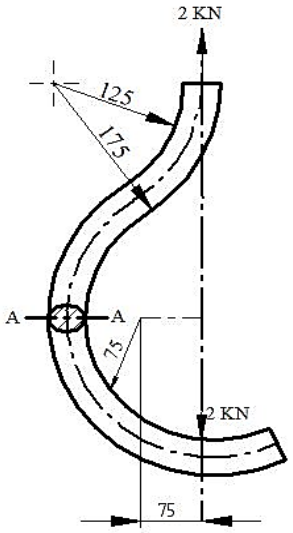

Fig. Q1 (b)

OR

2. a) Calculate the wire dia, coil dia and active number of coils for a compression helical spring to carry a load of 500 N with a deflection of 25 mm. The spring index may be taken as 8. Assume permissible shear stress is 350 MPa and modulus of rigidity is 84 GPa. **10**

   b) Find the thickness of semi elliptical spring 1 m span carrying a load of 5400 N. The permissible stress for the spring is 490 MPa. Also calculate the width, if- i) Leaves are unstressed initially ii) Leaves are stressed initially. **10**

   Take y= 75 mm, i_f= 2, i_g= 6, and E= 210GPa.

UNIT - II

3. a) A multiple plate clutch is required to transmit 25 kW of power at 1400 rpm. The maximum and minimum diameters of discs are 300mm and 100 mm respectively. Assuming coefficient of friction as 0.2, pressure between contact surfaces= 0.08MPa. Determine **10**

   i) The axial force required to engage the clutch

   ii) The number of friction surfaces

   iii) The number of discs on the driver and driven shafts.

   Assume Uniform wear condition.

   b) A simple band brake of diameter 600 mm has a band passing over it with an angle of contact of 225^0, while one end is connected to the fulcrum, other end is connected to the brake lever at a distance of 400 mm from the fulcrum as shown in Fig. Q3(b). The brake lever is 1 meter long. The brake is to absorb a power of 15 kW at 720 rpm. Design the brake lever of rectangular cross section, assuming depth to be thrice the width. Take allowable stress as 80 MPa. Assume $\mu = 0.3$. **10**

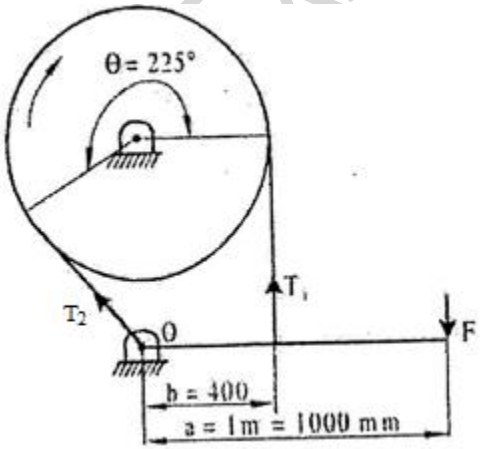

Fig. Q3 (b)

UNIT - III

4. a) Derive Lewis equation for beam strength of spur tooth profile along with 2 assumptions. **04**

   b) In a spur gear arrangement, a pinion made of cast steel is rotating at 900 rpm and is driving a cast iron gear at 150 rpm. The teeth are to have standard 20^0 stub involute profiles and the maximum power to be transmitted is 25 KW. Determine the module and the face width. Find the dynamic and wear load also. The pinion has 16 teeth with surface hardness of 250 BHN, take static stress for pinion as 103 Mpa and for gear as 55 Mpa. Assume Service factor= 1.5, E_P=95GN/m^2 and E_G=207GN/m^2. **16**

OR

5. a) Obtain an expression for formative number of teeth for a bevel gear. **05**

   b) A pump is driven by 30kW motor through a pair of right-angled bevel gears. The speed of the motor is 1200 rpm. The pinion of the motor has a pitch circle diameter of 150 mm and carries 30 teeth and the gear on pump shaft carries 40 teeth. The pinion is made of C45 steel untreated (σ_0= 233.4 MPa, BHN=200) whereas the gear is made of 0.2% cast steel untreated (σ_0= 138.3 MPa, BHN=180). The teeth are generated to have 20^0 full depth involute. Check whether the gear pair is safe from the standpoint of bending strength. **15**

UNIT - IV

6. a) Derive Petroff's equation for a lightly loaded journal bearing. **08**

   b) A full journal bearing of 50 mm diameter and 50 mm long operates at 1000 rpm and carries a load of 5 kN. The radial clearance is 0.025 mm. The bearing is lubricated with SAE 30 oil and operating temperature of oil is 80^0C. Assume the attitude angle as 60^0, determine: **12**

   i) Bearing pressure

   ii) Sommerfeld number

   iii) Attitude

   iv) Minimum film thickness

   v) Heat generated.

UNIT - V

7. a) Select a wire rope to lift 10kN of debris from a mine shaft 600 m deep. The weight of bucket is 2.5 kN. The maximum velocity of 20 m/s is attained in 5 seconds. **10**

   b) Select a suitable roller chain drive to transmit 10kW from a 1200 rpm motor to a compressor at 400 rpm. The center distance is adjustable to 800 mm. The service is 24 hours/day. Assume a factor of safety as 14. **10**

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