

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem. - V - Examination – June- 2011

Subject code: 152503

Subject Name: Design of Machine Elements - I

Date: 24/06/2011

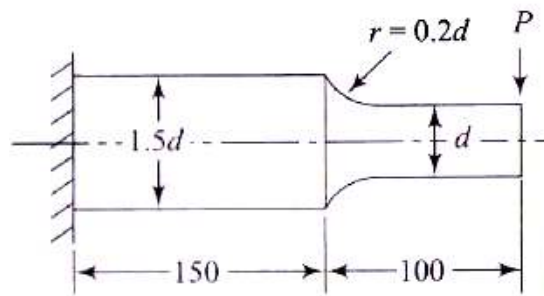
Time: 10:30 am – 01:00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Define stress concentration. Sketch different methods of mitigation of stress concentration. **07**
- (b)** A cantilever beam of 40C8 steel with ultimate tensile strength of 600 MPa as shown in Fig. 1 is subjected to a load varying from -50 N to 150N. Surface finish factor = 0.76, size factor = 0.85, reliability factor = 0.879 and notch sensitivity is given as 0.9. Determine the diameter 'd', considering the factor of safety as 1.5 and theoretical stress concentration factor as 1.35. **07**

**Fig. 1**

- Q.2 (a)** Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures. **07**
- (b)** A railway wagon of mass 20,000 Kg moving with a velocity of 2m/sec is brought to rest by two buffers of springs of mean diameter 300 mm. The maximum deflection of spring is 200 mm. Permissible shear stress is 600 MPa. Modulus of rigidity as 80 KN/mm². Find the diameter of spring and number of turns. **07**

OR

- (b)** A spring loaded safety valve is held against its seat by a close coiled helical compression spring. The diameter of the valve is 75 mm. Normal pressure on valve be 1 MPa and blow of pressure is 1.1 MPa. The deflection of spring causing the opening of valve is 3.5 mm and mean diameter of the coil is 100 mm. Find the diameter of spring bar and the number of active coils, if permissible shear stress is 500 MPa and modulus of rigidity is 80 KN/mm². **07**

- Q.3 (a)** Design a pair of spur pinion and gear made of cast steel and cast iron respectively. The diameter of pinion is 140 mm and it transmits 30 Kw power at 1250 rpm. The gear ratio is 3:1 and teeth are 20° full depth involute. Permissible static bending stress for pinion is 110 MPa and for gear is 55 MPa. **07**

- (b)** Two precision cut forged steel helical gears have 20° full depth involute teeth. For the given following parameters, find the transmitted and wear load and state whether the design is safe or not. **07**

The angle of helix is 23°.

Permissible static bending stress is 100 MPa.

Module is 3 mm and face width is 30 mm.

The speed of rotation of pinion is 600 rpm.

Gear ratio is 3:1.

Surface endurance strength is 630 MPa.

OR

- Q.3 (a)** Find the power transmitted by a pair of bevel gears with 20° full depth involute teeth. The material is steel with hardness 350 BHN. Consider Module as 6.5 mm and face width 60 mm. Pinion rotates at 600 rpm. The shafts are perpendicular to each other. Take load stress factor as 0.96 N/mm². Deformation factor is 300 N/mm. The pinion has 40 teeth and gear has 60 teeth. Safe static stress for the material is 105 MPa. **07**

- (b)** For a hardened steel worm and gear the centre distance is 450 mm. Transmission ratio is 20. Find the axial module and the lead angle. **07**

- Q.4 (a)** A clutch plate with maximum diameter 60 mm has maximum lining pressure of 0.35 MPa. The power to be transmitted at 400 rpm is 135 Kw and coefficient of friction is 0.3. Find inside diameter and spring force required to engage the clutch. If 6 springs are used with spring index 6 and material as spring steel having safe shear stress 600 MPa, find the wire diameter. **07**

- (b)** For the internal expanding single shoe brake as shown in the Fig. 2, maximum pressure between the lining and the drum is limited to 0.6 MPa. Coefficient of friction is 0.25 and width of the lining is 65 mm. Find the torque about the point 'O' and magnitude of force 'P'. **07**

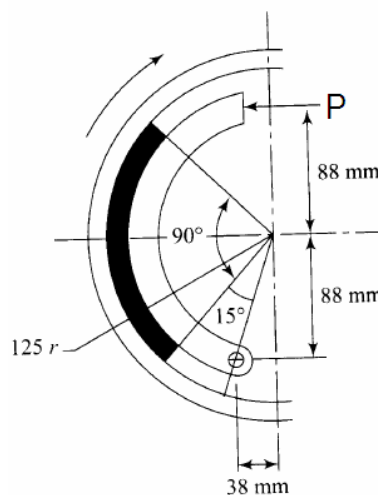


Fig. 2

OR

- Q.4 (a)** Discuss the different types of belts. A leather belt of 125 mm wide and 6 mm thick transmits power from a pulley of diameter 750 mm at 500 rpm. Angle of lap for smaller pulley is 150° , coefficient of friction is 0.3, mass of the belt is 1000 Kg/m^3 and the maximum permissible stress is 2.75 MPa. Find the maximum power that can be transmitted. **07**
- (b)** Describe with the help of neat sketch, a centrifugal clutch and deduce an expression for the total frictional torque transmitted. How the shoes are designed for such a clutch? **07**
- Q.5 (a)** Cast Iron fly wheel used for a four stroke engine developing 150 Kw power at 200 rpm. Calculate the diameter of the flywheel rim if the hoop stress is not to exceed 4 MPa. Total fluctuation of speed is to be 4 % of the mean speed. Work done during the power stroke may be assumed to be 1.5 times the average work done during the cycle. Density of cast iron is 7200 kg/m^3 . **07**
- (b)** What is the difference between column and strut? What are the different types of end conditions based on Eulers' column theory? Define "slenderness ratio". **07**

OR

- Q.5 (a)** Sketch the stress distribution of hoop and radial stress for a compound cylinder subjected to internal pressure. Why compound cylinder is better than single solid cylinder? **07**
- (b)** Derive the expression to determine wrench torque required for bolt tightening. **07**
