

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER V • EXAMINATION – WINTER - 2012****Subject code: 152503****Date: 17-01-2013****Subject Name: Design of Machine Elements-I****Time: 02:30 pm to 05:00 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) What do you mean by endurance strength of a material? How do the size and surface condition affect such strength? **07**

(b) Derive an expression for Beam strength of the Spur gear. **07**

Q.2 (a) Derive an expression for torque transmitting capacity of a multi-plate clutch. **07**

(b) A simple band brake operates on a drum of 60 cm in diameter that is running at 250 rpm. The coefficient of friction is 0.25. The brake band has a contact of 270° , one end is fastened to a fixed pin and the other end to the brake arm 125 mm from the fixed pin. The straight brake arm is 750 mm long and placed perpendicular to the diameter that bisects the angle of contact. What is the pull necessary on the end of the brake arm to stop the wheel if 35 KW is being absorbed? **07**

OR

(b) Prove that the maximum fluctuation of energy $\Delta E = E * 2 C_s$ **07**
Where E is mean kinetic energy of the flywheel and
 C_s is coefficient of fluctuation of speed.

Q.3 (a) How worm gears are designated and explain the terms in it. **02**

(b) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20° , while the helix angle 25° . The face width is 40 mm and the normal module is 4 mm. The pinion as well as the gear are made of steel 40C8 having ultimate tensile strength of 600 N/mm² and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears. **12**

OR

Q.3 (a) Design a pair of spur gears with 20° full depth involute teeth. The input shaft rotates at 720 rpm and receives 5 KW power through flexible couplings. The speed of the output shaft should be 144 rpm. The pinion as well as gear is made of steel Fe 410 having ultimate tensile strength as 410 N/mm². The service factor for the application is 1.25. The gears are machined to meet the specifications of Grade 8, for which tolerance value is given as $e = 16 + 1.25 (m + 0.5 * d^{0.5})$. **12**

No of teeth on the pinion are 18.

a) For preliminary calculations, assume the pitch line velocity as 5 m/s and the factor of safety as 2. Estimate the module and dimensions of the pinion and gears.

b) Determine the static and dynamic loads from Spott's equation. Also calculate beam strength and correct value of factor of safety based on beam strength.

c) Using factor of safety of 2 for wear strength, calculate the effective load

and specify the surface hardness of gears.

- (b) What do you mean by formative number of teeth in case on helical gears? 02

- Q.4 (a) Explain different types of Pressure vessel supports. 07

- (b) Design a helical compression spring for an engine valve from the following data: 07

Maximum Load	: 1050 N
Minimum Load	: 850 N
Lift of valve	: 4 mm
Spring Index	: 5
Allowable stress	: 470 N/mm^2
Modulus of Rigidity	: $8 \times 10^4 \text{ N/mm}^2$

OR

- Q.4 (a) Explain Nipping of springs with neat sketch. 07

- (b) A closed vessel is to be designed to withstand an internal pressure of 50 MPa having inside diameter of 45 cm. The properties of the vessel material are yield strength is 300 MPa, ultimate tensile strength is 500 MPa, Poisson's ratio = 0.3. Determine the required wall thickness of the vessel using a factor of safety of 1.5 based on yield strength on the basis of i) maximum principal stress theory, ii) maximum shear stress theory. 07

- Q.5 (a) A rectangular plate with a central hole is subjected to a completely reversed axial load of 20 kN as shown in figure 5.1. The notch sensitivity can be assumed as 0.8. Determine the plate thickness for finite life, if the factor of safety is 2. 07

Assume the ultimate tensile strength as 500 MPa. The surface factor is 0.8, size factor is 0.85 and the calculations are expected at 90 % reliability, for which the reliability factor is 0.897. The theoretical stress concentration factor may be taken as 2.5.

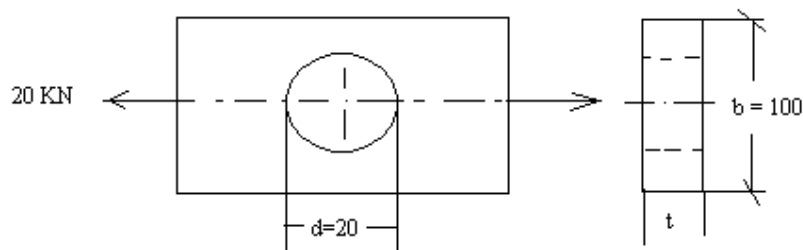


Figure 5.1

- (b) Derive an expression of length of cross belt drive 07

OR

- Q.5 (a) Determine the thickness of plain cylinder head for 300 mm cylinder. The maximum gas pressure is 3.2 N/mm^2 . Also design the studs for the cylinder cover. 07

Take: For Cast iron cylinder, $\sigma_t = 42 \text{ N/mm}^2$ and $C = 0.1$

For stud material, $\sigma_t = 63 \text{ N/mm}^2$

- (b) Differentiate between strut and column. Explain different types of end conditions based on Euler's theory. 07
