

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V • EXAMINATION – SUMMER 2013****Subject Code: 152503****Date: 21-05-2013****Subject Name: Design of Machine Elements-I****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)** Explain the following terms in connection with design of machine members subjected to variable load. **07**
(I) Endurance limit, (II) Size factor, (III) Notch sensitivity, and (IV) Surface finish factor.
- (b)** What is meant by stress concentration? Illustrate how the stress concentration in a component can be reduced. **07**
- Q-2 (a)** Name the different types of theories of failure under static load when subjected to biaxial stress. Explain in brief two theories for ductile material and brittle materials. **07**
- (b)** The Load on a bolt consist of an axial pull of 10 KN together with a transverse shear force of 5 KN. Find the diameter of bolt required according to (a) Maximum principal stress theory; and (b) Maximum principal strain theory. Take permissible tensile stress = 100 N/mm² and poissons ratio 0.3. **07**
- OR
- (b)** A cylindrical shaft made of steel of yield strength 700 N/mm² is subjected to static loads consisting of banding moment 10 KN-m and torsional moment 30KN-m. Determine the diameter of shaft using maximum shear stress theory and assuming factor of safety 2. **07**
Take $E=2.1 \times 10^5$ N/mm² and poissons ratio 0.25.
- Q-3 (a)** Explain the design procedure of differential bend brake to satisfy the condition of self locking. **07**
- (b)** An engine developing 45KW at 1000 r.p.m. is fitted with a cone clutch built inside the fly wheel. The cone has a face angel of 12.5° and a maximum mean diameter of 500mm. The co-efficient of friction is 0.2. The normal pressure on the clutch face is not to exceed 0.1 N/mm². Determine (a) The face width required (b) The axial spring force necessary to engage the clutch. **07**
- OR
- Q-3 (a)** Explain with the help of neat sketch the working principal of centrifugal clutch. **07**
- (b)** A bend break acts on the 75% of circumference of a drum of 450mm diameter which is keyed to the shaft. The bend break provides a braking torque of 225 NM. One end of the bend which is horizontal along the leaver attached to a fulcrum pin of the leaver. The other end of the bend is attached to the leaver 100mm from the fulcrum. If the operating force applied at 500mm from the fulcrum and the co-efficient friction is 0.25 find the operating force required. **07**
If the brake leaver and pins are made explain of m.s. having permissible stresses for tension and crushing as 70N/mm² and for shear 56N/mm². Design the shaft and key for the drum.

- Q-4 (a)** Explain the phenomenon of interference in involute gears. What are the conditions to be satisfied in order to avoid interference? **07**
- (b)** Write the expressions for the static strength, limiting wear load and dynamic load for helical gears and explain the various terms used there in. **07**

OR

- Q-4 (a)** A pair of straight teeth spur gears is to transmit 20KW at 300r.p.m. The velocity ratio is 1:3. The allowable static stresses for the pinion and gear materials are 120 N/mm² and 100N/mm² respectively. **07**

The pinion has 15 teeth and its face width is 14 times the module. Determine (a) Module, (b) Face Width and (c) Pitch Circle Diameters.

$$\text{Take form factor } y = 0.154 - \frac{0.912}{\text{No. of Teeth}} \quad \text{and}$$

$$\text{Velocity factor } C_v = \frac{3}{3 + v} \quad v \text{ is in m/s.}$$

- (b)** A helical cast steel gear with 30° helix angle has to transmit 35kw at 1500r.p.m. If the gear has 24 teeth, Determine necessary module, pitch circle diameter and face width for 20° full depth teeth. The static stress may be taken as 56 N/mm². The width of the face may be taken as 3 times the normal pitch. What would be the end thrust on the gear? **07**

$$\text{Take tooth factor } y' = 0.154 - \frac{0.912}{z'} \quad z' = \text{formative number of teeth}$$

$$\text{Velocity factor } v = \frac{15}{15 + v} \quad v = \text{peripheral velocity}$$

- Q-5 (a)** Name the methods used to design thick cylinder to withstand internal pressure equal to or greater than the allowable working stress. **07**

Also show the stress distribution across the wall thickness due to shrinkage fitting and internal fluid pressure.

- (b)** A leather belt 9mm×250mm is used to drive a cast iron pulley 900mm in diameter at 336r.p.m. If the active arc of contact on the smaller pulley is 120° and allowable tensile stress is 2N/mm². Find the power capacity of the belt. The density of leather belt is 980kg/m³ and coefficient of friction is 0.35 **07**

OR

- Q-5 (a)** Design a helical compression spring for maximum load of 1000 N for a deflection of 25mm using value of spring index as 5. The maximum allowable shear stress for spring wire is 420 N/mm² and modulus of rigidity is 0.84×10⁵N/mm². **07**

- (b)** Determine the dimensions of an I section connecting rod for a petrol engine from the following data. **07**

Piston diameter 110mm, mass of the reciprocating parts = 2Kg, Length of the CR = 325mm Stroke length 150mm maximum speed 2500r.p.m. Compression ratio = 4, maximum pressure = 2.5 N/mm² take I section 4t×5t. factor of safety 6.
