

Enrollment No: \_\_\_\_\_ Exam Seat No: \_\_\_\_\_

# C.U.SHAH UNIVERSITY

## Summer Examination-2017

Subject Name: Machine Design - I

Subject Code: 4TE06MDE1

Branch: B.Tech (Mechanical)

Semester: 6

Date: 17/04/2017

Time: 02:30 To 05:30

Marks: 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
  - (2) Instructions written on main answer book are strictly to be obeyed.
  - (3) Draw neat diagrams and figures (if necessary) at right places.
  - (4) Assume suitable data if needed.
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- Q-1 Attempt the following questions: (14)**
- a) The maximum energy which can be stored in a body up to the elastic limit is called **01**
- A) Resilience
  - B) Proof Resilience
  - C) Modulus of Resilience
  - D) Strain Energy
  - E) None
- b) An Aluminum member is designed based on **01**
- A) Yield stress
  - B) Elastic limit stress
  - C) Proof stress
  - D) Ultimate stress
  - E) Bearing stress
- c) Hot working of metals is carried out **01**
- A) Above the recrystallization temperature
  - B) below the recrystallization temperature
  - C) at the recrystallization temperature
  - D) at higher temperature
- d) The factor of safety for machine parts subjected to reversed stresses is **01**
- A) Ratio of yield strength to maximum stress
  - B) Ratio of endurance limit to amplitude stress
  - C) Ratio of ultimate tensile strength to maximum stress
  - D) Ratio of endurance limit to mean stress
- e) When the helical torsion spring is subjected to torque , the type of stress induced in the spring wire is **01**
- A) Tensile stress
  - B) Compressive stress
  - C) Bending stress



- D) Torsional shear stress
- f) For a closed thin cylinder shell subjected to an internal pressure and this tensile stress acting in the direction of the axis is called longitudinal stress which **01**  
 A) Equal to the circumferential stress  
 B) Half of the circumferential stress  
 C) Double to the hoop stress  
 D) Equal to Zero
- g) In thick Cylinder it is observed that **01**  
 A) Radial stresses is maximum at Outer radius  
 B) Tangential stresses maximum at Inner radius  
 C) Radial and Tangential stresses maximum at Inner radius  
 D) Radial and Tangential stresses minimum at Inner radius
- h) The effect of centrifugal tension on Power transmission using flat belt drive is **01**  
 A) Maximum  
 B) Minimum  
 C) No effect  
 D) None
- i) The cast iron pulleys are generally made with rounded rims, this slightly convexity is known as **01**  
 A) Clowning  
 B) Rim  
 C) Arm  
 D) Crowning
- j) In order to have smooth operation, the maximum number of teeth on the smaller sprocket, for moderate speeds, should be **01**  
 A) 25  
 B) 21  
 C) 17  
 D) 15
- k) The helical spring designed based on **01**  
 A) Gerber method  
 B) Goodman Method  
 C) Soderberg Method  
 D) None of the above
- l) The axial force ( $W_e$ ) required for engaging a cone clutch is given by **01**  
 A)  $W_n \sin\alpha$   
 B)  $W_n (\sin\alpha + \mu \cos\alpha)$   
 C)  $W_n (\sin\alpha + 0.25 \mu \cos\alpha)$   
 D) None
- m) The property of a bearing material which has the ability to accommodate small particles of dust, grit etc., without scoring the material of the journal is called **01**  
 A) Bondability  
 B) Embeddability  
 C) Conformability  
 D) Fatigue strength
- n) The ball bearings are provided with a cage **01**  
 A) to reduce friction



- B) to facilitate slipping of balls
- C) to prevent the lubricant from flowing out
- D) to maintain the balls at a fixed distance apart

**Attempt any four questions from Q-2 to Q-8**

**Q-2 Attempt all questions (14)**

- a) Explain Thermal and Wear consideration. **07**
- b) Explain the Soderberg diagram and Goodman's diagram with neat sketch. Why modified Goodman diagram is required? **07**

**Q-3 Attempt all questions (14)**

- a) A shrink fit assembly, formed by shrinking one tube over another, is subjected to an internal pressure of  $60 \text{ N/mm}^2$ . Before the fluid is admitted, the internal and the external diameters of the assembly are 120 mm and 200 mm and the diameter at the junction is 160 mm. If after shrinking on, the contact pressure at the junction is  $8 \text{ N/mm}^2$ , determine using Lamé's equations, the stresses at the inner, mating and outer surfaces of the assembly after the fluid has been admitted. **10**
- b) What is critical frequency? How it can be Eliminate? **04**

**Q-4 Attempt all questions (14)**

- a) What are the main disadvantages of Helical Spring of Non-circular Wire? **02**
- b) A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is  $30^\circ$ . The cross-sectional area of each belt is  $750 \text{ mm}^2$  and  $\mu = 0.12$ . The density of the belt material is  $1.2 \text{ Mg/m}^3$  and the maximum safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 r.p.m. Find also the shaft speed in r.p.m. at which the power transmitted would be a maximum. **06**
- c) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque which fluctuates between 2000 N-m to -800 N-m. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. **06**

**Q-5 Attempt all questions (14)**

- a) Determine the following for a plate clutch to transmit the power : **08**
  1. Diameter of shaft assuming shear stress as 40 MPa
  2. Mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4,
  3. Outer and inner radius of the clutch plate,
  4. Dimensions of the spring, assuming that the number of springs are 6, spring index=6 and  $G= 84 \text{ GPa}$ . The allowable shear stress for the spring wire taken as 420 MPa.
- b) Design a cone clutch considering uniform pressure. **06**

**Q-6 Attempt all questions (14)**

- a) Following data refer to a journal bearing of a CF Pump: **10**  
→ Diameter of Shaft = 60 mm



- Load supported = 28 kN
- Journal Diameter = 60.06 mm
- Operating Speed = 900 RPM
- Minimum thickness of oil film = 0.015 mm

Find,

- I. Suitable value of SAE -10 Oil ,Viscosity at 62 °C
- II. Power lost in friction
- III. State whether the bearing is working under hydrodynamic condition or not? Assuming a bearing modulus of 15.

Use the Equation  $S = \left[ \frac{\mu n}{p} \right] \left( \frac{r}{c} \right)^2 = 0.0823 \frac{[2 + \sqrt{1 - \epsilon^2}]}{\pi^2 \epsilon}$

Where,  $\epsilon$  = attitude of bearing

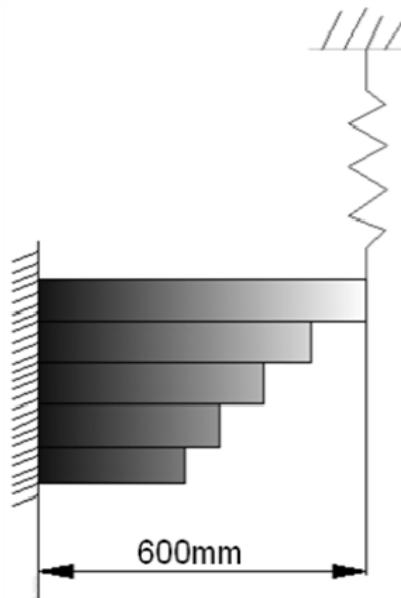
b) What is Autofrettage? 04

**Q-7**

**Attempt all questions**

**(14)**

a)



A 100mm outside diameter steel coil spring having 10 active coils of 12.5 diameter wire is in contact with a 600mm long steel cantilever spring having 5 graduated leaves 100mm wide and 10 mm thick as shown in figure.

- i) What force “F” is gradually applied to the top of the coil spring will cause the cantilever to deflect by 50mm
  - ii) What is the bending stress in cantilever beam?
  - iii) What is the shear stress in coil spring?
  - iv) What energies stored by each spring.
- Take  $E=210$  GPA and  $G=84$  GPa, For constant width varying depth take  $C_1 = 6$  and  $C_2 = 8$

**10**

b) What does the term “uniform strength” in the context of leaf spring mean? 04

**Q-8**

**Attempt all questions**

**(14)**

- a) Draw the stress distribution diagrams for thick cylinder subjected to internal and external pressure & Derive its equation? 10
- b) Where are the angular contact and self-aligning ball bearings used? Draw neat sketches of these bearings. 04

