

# C.U.SHAH UNIVERSITY

## Summer Examination-2016

**Subject Name: Machine Design - I**

**Subject Code: 4TE06MDE1**

**Branch: B.Tech.(Mechanical)**

**Semester: 6 Date: 11/05/2016**

**Time: 2.30 To 5:30**

**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.
  - (5) Use of PSG Design Data Book is permitted in exam
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**Q-1**

**Attempt the following questions:**

**(14)**

- a) Rolling contact bearings as compared to sliding contact bearings have
  - (a) lower starting torque
  - (b) require considerable axial space
  - (c) generate less noise
  - (d) costly
- b) A V belt designated as B 4430 Lp has
  - (a) 4430 mm as diameter of small pulley
  - (b) 4430 mm as nominal pitch length
  - (c) 4430 mm as diameter of large pulley
  - (d) 4430 mm as centre distance between pulleys
- c) The clutch used in scooters is
  - (a) multi-plate clutch
  - (b) single plate clutch
  - (c) centrifugal clutch
  - (d) cone clutch
- d) The endurance limit of the component can be increased by
  - (a) increasing the size of component
  - (b) shot peening
  - (c) increasing the stress concentration
  - (d) coating
- e) The suitable material for belt used in floor mill is
  - (a) leather
  - (b) rubber
  - (c) canvas or cotton duck
  - (d) balata gum
- f) The maximum shear stress in spring wire is induced at
  - (a) inner surface of the coil
  - (b) outer surface of the coil
  - (c) central surface of the coil
  - (d) end coils
- g) The objective of 'crowning' of the flat pulleys of belt drive is to



- (a) prevent the belt from running off the pulley
- (b) increase the power transmission capacity
- (c) increase the belt velocity
- (d) prevent the belt joint from damaging the belt surface
- h)** A brake commonly used in motor cars is
  - (a) shoe brake
  - (b) band brake
  - (c) band and block brake
  - (d) internal expanding brake
- i)** The catalogue life of bearing is
  - (a) minimum life that 90% of the bearings will reach or exceed
  - (b) maximum life for 90% of the bearings
  - (c) average life
  - (d) median life
- j)** The balls of rolling contact bearings are made of
  - (a) case hardened steel
  - (b) plain carbon steel
  - (c) high carbon chromium steel
  - (d) free cutting steel
- k)** The thickness of thin cylinder is determined on the basis of,
  - (a) radial stress
  - (b) longitudinal stress
  - (c) circumferential stress
  - (d) principal shear stress
- l)** While designing pressure vessels according to 'Code for unfired vessel IS- 2825', the design pressure is taken as
  - (a) 1.05(maximum operating pressure)
  - (b) 1.5(maximum operating pressure)
  - (c) 2(maximum operating pressure)
  - (d) 1.3(maximum operating pressure)
- m)** The criterion of failure for machine parts subjected to fluctuating stresses is
  - (a) ultimate tensile strength
  - (b) yield strength
  - (c) endurance limit
  - (d) modulus of elasticity
- n)** The number of teeth on sprocket should be odd in order to
  - (a) reduce polygonal effect
  - (b) reduce wear
  - (c) reduce back sliding
  - (d) evenly distribute wear on all sprocket teeth

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

**Q-2**

**Attempt all questions**

- a)** Explain the following terms: **03**
  - (i) Preferred numbers (ii) Standardization (iii) Hertz's Contact stress
- b)** Explain the important considerations to be considered in casting design. **04**
- c)** A machine component is subjected to fluctuating stress that varies from 60 to 100 MPa. The corrected endurance limit stress for the machine component is 270 MPa. The ultimate tensile strength and yield strength of material are 600 and 450 MPa respectively. Calculate the factor of safety using 1. Gerber theory, 2. Soderberg line and 3. Goodman line **07**



**Q-3**

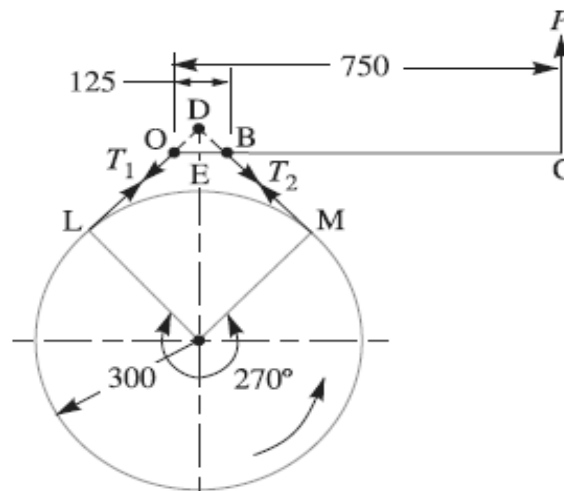
**Attempt all questions**

- a) Explain the wear considerations in design. **03**
- b) Define the following terminology related to helical spring : (a) Spring index (b) spring stiffness (c) Wahl's stress factor (d) surge in spring **04**
- c) A rail wagon of mass 20 tonnes is moving with a velocity of 2 m/s. It is brought to rest by two buffers with springs of 300mm diameter. The maximum deflection of springs is 250 mm. Modulus of rigidity for spring material =  $0.84 \times 10^5$  MPa. The allowable shear stress in the spring material is 600 MPa. Design the spring for the buffers. **07**

**Q-4**

**Attempt all questions**

- a) Justify "Multiple plate clutches are used on two wheelers while single plate clutches are used on four wheelers" **03**
- b) Explain the important parameters affecting the design of journal bearing. **04**
- c) A simple band brake shown in Figure-1 operates on a drum of 600 mm in diameter that is running at 200 r.p.m. The coefficient of friction is 0.25. The brake band has a contact of  $270^\circ$ ; 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. (a) What is the pull necessary on the end of the brake arm to stop the wheel if 35 kW is being absorbed? What is the direction for this minimum pull? (b) What width of steel band of 2.5 mm thick is required for this brake if the maximum tensile stress is not to exceed 50 MPa? **07**



**Q.4- C- Figure-1**

**Q-5**

**Attempt all questions**

- a) State the different belt tension adjustment devices and explain one of them in detail with neat sketch. **03**
- b) Explain the construction and working of internal expanding shoe brake with neat sketch. **04**
- c) Design a single plate clutch considering uniform wear criterion and effective one pair of contacting surfaces from the following specification: Power to be transmitted = 18.5 kW, Speed = 750 r.p.m., Outer diameter = 2 times internal **07**



diameter, Permissible pressure for the lining = 1 MPa, Coefficient of friction = 0.20, Permissible stress for shaft material = 45 MPa

**Q-6**

**Attempt all questions**

- a) Discuss the pressure vessel types and materials. **03**
- b) Explain Pre stressing and autofrettage for cylinders. **04**
- c) A high pressure cylinder consists of steel tube with 30 mm and 60 mm as inner and outer diameter respectively. It is jacketed by outer steel tube with 80 mm outer diameter. The tubes are assembled by shrinking process in such a way that the maximum principal tensile stress in any tube is restricted to 80 MPa. Take  $E = 2.1 \times 10^5$  MPa, Find the shrinkage pressure, Interference required and original dimension of the tube. **07**

**Q-7**

**Attempt all questions**

- a) State advantages of chain drives over belt drives. **03**
- b) What do you mean by 6x 9 ropes? Discuss about the stresses acting on wire rope and write its design procedure in brief. **04**
- c) A flat belt drive transmits 50 kW at 25 m/s. The mass of the belt is 1.75 kg per metre of belt length and width the belt is 180 mm. The belt drive is cross belt drive having driver pulley of 350 mm and driven pulley of 1050 mm. The centre distance between two pulleys is 5 m. Calculate the length of belt; angle of contact; belt tensions and thickness of belt. Take mass density of belt =  $1000 \text{ kg/m}^3$  and coefficient of friction between belt and pulley surface = 0.35. **07**

**Q-8**

**Attempt all questions**

- a) A ball bearing is subjected to a radial load of 5 kN, is expected to have a life of 8000 hours at 1450 rpm with a reliability of 99%. Calculate the dynamic load capacity of the bearing, so that it can be selected from the manufacturer's catalogue based on a reliability of 90%. **07**
- b) Design a journal bearing from the following data: Radial load = 20 kN, Diameter of journal = 100 mm, Speed of journal = 900 r.p.m, Oil SAE 10 with viscosity at  $55^\circ \text{C} = 0.017 \text{ kg/m-sec}$ , Ambient temperature =  $15.5^\circ \text{C}$ , Maximum bearing pressure = 1.5 MPa, permissible rise in oil temperature =  $10^\circ \text{C}$ , heat dissipation coefficient =  $1232 \text{ W/m}^2/^\circ\text{C}$ , L/D ratio = 1.6, Design parameter  $ZN/p = 28$ , clearance ratio = 0.0013, specific heat of oil =  $1900 \text{ J/kg}^\circ\text{C}$  **07**

