

GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER – V (NEW) EXAMINATION – WINTER 2015

Subject Code: 2151907

Date: 10/12/ 2015

Subject Name: Design of Machine Elements

Time: 10:30am to 1:00pm

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)** State and illustrate various principal design rules as per Casting Design **07**
(b) State and illustrate various principle design rules used in design for forging **07**
- Q.2 (a)** Answer the following: **07**
(i) Explain buckling of spring in detail.
(ii) Explain the designing for wear.
- (b)** Design a helical compression spring from the following data: **07**
Minimum load = 100 N ,Maximum load = 225.6 N ,Compression of spring = 10 mm ,Permissible shear stress for spring material = 440 MPa Spring end – square and ground ends Modulus of rigidity for spring material = 0.80×10^5 MPa
- OR**
- (b)** A semi-elliptic leaf spring consists of two extra full length leaves and eight graduated length leaves, including the master leaf. The center to center distance between the two eyes of the spring is 1 m. The maximum force acting on the spring is 10 kN and the width of the leaf is 50 mm. The spring is initially preloaded in such a way that when the load is maximum, the stresses induced in all the leaves are equal to 350 N/mm^2 . The modulus of elasticity of the leaf material is $2.07 \times 10^5 \text{ N/mm}^2$. Determine : (i) The thickness of leaves. (ii) The deflection of the spring at maximum load. **07**
- Q.3 (a)** Derive Soderberg's equation and state its application to different types of loadings. **07**
(b) The following data refers to a transmission shaft : Torsional moment that varies from - 100 Nm to + 600 Nm. Ultimate tensile strength = 630 MPa, Yield strength = 360 MPa, Stress load correction factor = 0.6, Size correction factor = 0.85, Surface finish factor = 0.8, Reliability factor = 0.897, Factor of safety = 2, Calculate the shaft diameter using distortion energy theory of failure. **07**
- OR**
- Q.3 (a)** Answer the following: **07**
(i) Design for creep
(ii) Factors affecting endurance strength of the materials
- (b)** A machine component is subjected to fluctuating stress that varies from 40 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.4 (a)** (i) Explain any two type of chain with neat sketches. **05**
(ii) Explain the polygon action of chain. **02**

- (b) 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 kg/m³ and coefficient of friction between belt and pulley surface=0.35. **07**

OR

- Q.4 (a)** Derive the expression of a ratio of driving tensions for the flat belt drive. Explain the effect of centrifugal tension on ratio of driving tensions in brief. **07**
- (b)** Two V Belts of section B are transmitting power on grooved pulleys. Angle of Groove is 35°. Belt angle is 40°. The driver pulley of 300 mm runs at 1500 rpm and driven pulley is 600 mm diameter. The coefficient of friction between belt and pulley is 0.3. If the power transmitted is 150 kW, determine (i) Centrifugal tension (ii) maximum tension, (iii) length of the belt for open drive. (iv) designation of the belt, (v) the speed at which maximum power can be transmitted The mass of the belt is 0.193 kg per m length For Section B Belt. Assume centre distance between pulleys is 900 mm. **07**
- Q.5 (a)** Explain Clavarino's and Birnie's equation in detail. **07**
- (b)** A cast iron pipe of internal diameter 200 mm and thickness of 50mm carries water under a pressure of 5 N/mm². Calculate the tangential and radial stresses at Radiuses (r)=100 mm; 110 mm; 130 mm; 140 mm and 150 mm. Sketch the stress distribution curves. **07**

OR

- Q.5 (a)** (i) Explain autofrettage for cylinders. **03**
(ii) Explain Area compensations for nozzles. **04**
- (b)** The piston rod of a hydraulic cylinder exerts pressure of 10 MPa. The internal diameter of the cylinder is 350 mm. The C.I. cover plate of thickness 15 mm is fixed to the cylinder by means of 8 bolts with a nominal diameter of 16 mm and zinc gasket of 5 mm thickness. The bolts are made of steel FeE350 ($\sigma_y = 350(N/mm^2)$). The flange thickness is 15 mm. Each bolt is initially tightened with a pre-load of 18 kN. Determine factor of safety of the bolts considering the effect of the gasket. Assume E for steel= 207 GPa; E for cast iron =100 GPa; E for Zinc=90 GPa. **07**
