

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2151907

Date: 03/06/2019

Subject Name: Design of Machine Elements

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.
4. Design data book is permitted

- Q.1**
- (a) Why metals in their pure form are unsuitable for industrial purpose? **03**
 - (b) Explain Hole base system and shaft base system in Machine design. **04**
 - (c) Explain principles of Design for Aesthetic and Ergonomics. **07**
- Q.2**
- (a) Explain the influence of various factors on endurance limit of a ductile material. **03**
 - (b) Explain cyclic stress characterization with mathematical formulations and graphs. **04**
 - (c) A 25 mm diameter shaft is made of forged steel 30C8 with $S_{ut}=600 \text{ N/mm}^2$. There is a step in the shaft the theoretical stress concentration factor at the step is 2.1. The notch sensitivity is 0.84. Determine the endurance limit of the shaft if it is subjected to a reversible bending moment. **07**
- OR**
- (c) A hot rolled steel shaft is subjected to torsional load that varies from 300 Nm clockwise to 100 Nm anti-clockwise as an applied bending moment at a critical section varies from +400Nm to -200Nm. The shaft is of uniform cross section and no keyway is present at the critical section. Determine the required diameter of shaft. Assume factor of safety is 1.5, $S_{ut}=560 \text{ MPa}$, $S_{yt}=420 \text{ MPa}$. **07**
- Q.3**
- (a) What is surge in spring? Explain the method of elimination of surge in spring. **03**
 - (b) Explain the merits and demerits of Non-circular cross section wire used in spring. **04**
 - (c) Calculate the dimensions of a helical spring for a spring loaded Ramsbottom safety valve from the following data: **07**
 Valve diameter = 65 mm,
 Maximum pressure when the valve blows off freely = 0.73 N/mm^2
 Valve lift when pressure rise from 0.7 to 0.73 N/mm^2 = 3.2 mm
 Maximum permissible stress = 500 N/mm^2
 Spring Index = 6
 Modulus of rigidity = $0.85 \times 10^5 \text{ N/mm}^2$.
- OR**
- Q.3**
- (a) Explain concentric spring and its applications. **03**
 - (b) Explain the effect of nipping of leaves in carriage spring. **04**
 - (c) Determine the cross section of the leaves of a carriage spring of semi elliptic shape, used as a suspension of a truck. There are 2 full-length leaves including master leaf and 8 graduated leaves. Spring eyes are located at 1180 mm. Take factor of safety as 2, Maximum load on spring as 40kN and Ultimate Tensile Strength S_{ut} of spring material as 1400 MPa. **07**
- Q.4**
- (a) What is the purpose of providing steel or nylon cords in the inner case of V-belt? **03**
 - (b) What are the application of Flat, V, Round and Timing belt belts in engineering? **04**

- (c) A Leather belt, 160 mm wide and 7 mm thick is used to transmit 3 kW under light shock load conditions for which service factor is 1.2. the driving pulley is of 160 mm diameter and operates at 1440 rpm. The driven pulley is 480 mm in diameter and centers of pulley are 2.4 m apart. Considering open belt drive, $w=11,200 \text{ N/mm}^3$ for belt, $\mu = 0.4$ between pulley and belt, and allowable tension per mm width at 3m/s is equal to 7.2 n/mm. Determine
 Centrifugal tensions,
 Tensions on tight and slacks sight,
 Factor of safety and
 Design power. 07

OR

- Q.4** (a) What is polygon effect in chain drive? How it is minimized? 03
 (b) Explain the procedure for selection of a standard V belt. 04
 (c) A simple chain no.06 B is used to transmit power from a transmission shaft running at 1000 rpm to another shaft running at 500 rpm. There are 21 teeth on driving sprocket wheel and operation is smooth without any shock. 07
 Calculate:
 1. power transmission capacity of the chain
 2. chain velocity
 3. chain tension
 4. factor of safety based on breaking load
 5. Length of chain if centre distance is 50p

- Q.5** (a) Which theory of failure is used while designing a pressure vessel? Why? 03
 (b) Derive the relation to determine the cylinder thickness based on maximum shear stress theory and maximum distortion energy theory. 04
 (c) A hydraulic cylinder with closed ends is subjected to an internal pressure of 15 MPa. The inner and outer diameters of the cylinder are 200 mm and 240 mm respectively. The cylinder material is cast iron FG300. Determine the factor of safety used in design. If the cylinder pressure is further increased by 50%, what will be the factor of safety? 07

OR

- Q.5** (a) Derive the expression of resultant load in terms of stiffness on the bolted assembly of Cylinder –Head-Gasket joints. 03
 (b) Explain the area compensations method to determine the area of reinforcement for a nozzle opening with neat sketch. 04
 (c) A thick cylinder 120 mm inner diameter and 180 mm outer diameter carries fluid under a pressure of 9 MPa. Find the tangential and radial stresses across the wall and sketch the stress distribution. 07
