

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2151907

Date:11/05/2016

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.

- Q.1** (a) What are preferred numbers? The maximum & minimum load carrying capacities of dumpers in a manufacturing unit are 40 KN and 630 KN respectively. The company is interested in developing seven models in this range. Specify their load carrying capacities. **05**
- (b) Explain the design consideration of castings process with sketches. **05**
- (c) Discuss the importance of selection of materials in machine design. **04**
- Q.2** (a) What is endurance strength? Discuss the factors affecting endurance strength of material. **07**
- (b) A cantilever beam made of carbon steel of circular cross-section as shown in figure -1, is subjected to a load which varies from $-F$ to $3F$. Determine the maximum load that the beam can sustain for an indefinite life. **07**
- Factor of safety = 2, Stress concentration factor = 1.42, Notch sensitivity = 0.9
Ultimate stress = 550 MPa , Yield stress = 470 MPa , Endurance limit = 275 MPa , Size factor = 0.85, Surface finish factor = 0.89

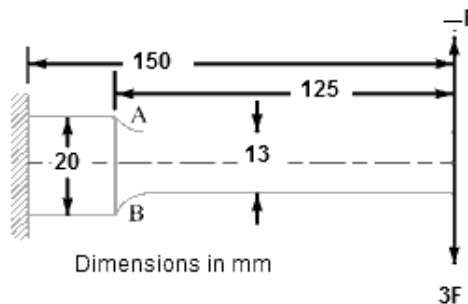


Figure - 1

OR

- (b) A hot rolled steel shaft is subjected to a torsional moment that varies from 330 Nm to -110 Nm and an applied bending moment at a critical section varies from 440 Nm to -220 Nm. The shaft is of uniform cross-section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MPa and yield strength of 410 MPa. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62. **07**
- Q.3** (a) What is crowning of the pulley? State the objectives of providing crowning. **03**
- (b) What is nipping in a leaf spring? Discuss its role. **04**
- (c) A helical compression spring made of oil tempered carbon steel is subjected to a fluctuating load from 400 N to 1000 N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, Find: 1. Size of the spring wire, 2. Diameters of the spring, 3. Number of turns of the spring, and 4. Free length of the spring. The compression of the spring at the maximum load is 30 mm. For spring material, the modulus of rigidity is 80 KN/mm². Spring ends are square and ground. **07**

OR

- Q.3** (a) What is pre-stressing the cylinder? What are the various methods used for it? **03**
(b) Explain surge phenomenon in spring? **04**
(c) A semi-elliptical laminated vehicle spring to carry a load of 6000 N is to consist of seven leaves 65 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1 m in length and attached to the axle by two U-bolts 80 mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Assume a design stress for spring material as 350 N/mm². Determine: 1.Thickness of leaves 2. Deflection of spring 3. Diameter of eye 4. Length of leaves Take E = 210 KN/mm², Bearing pressure = 8 N/mm². **07**

- Q.4** (a) Design a 10 mm thick rubber belt to drive a dynamo generating 20 KW at 2250 R.P.M. and fitted with a pulley 200 mm diameter. The dynamo efficiency to be 85%. Allowable stress for belt = 2.1 MPa, Density of rubber = 1000 kg/m³, Angle of contact for dynamo pulley = 165°, Coefficient of friction between belt and pulley = 0.3 **07**
(b) Derive an expression for the ratio of driving tensions of a V-belt drive. **07**

OR

- Q.4** (a) A compressor, requiring 90 KW, is to run at about 250 R.P.M. The drive is by V-belts from an electric motor running at 750 R.P.M. The diameter of pulley on compressor shaft must not be greater than 1 metre while the centre distance between the pulleys is limited to 1.75metre. The belt speed should not exceed 1600 meters/min. Determine the number of V-belts required to transmit the power if each belt has a cross-sectional area of 375 mm², density 1000 kg / m³ and an allowable tensile stress of 2.5 MPa. The groove angle of the pulleys is 35°. The coefficient of friction between the belt and the pulley is 0.25. Calculate also the length required of each belt. **07**
(b) Explain the step by step procedure used for design of chain drive system. **07**
- Q.5** (a) State the different equations used for the design of thick cylinder subjected to internal pressure based on materials and end conditions. **07**
(b) A high pressure cylinder consists of steel tube with 20 mm and 40 mm as inner and outer diameter respectively. It is jacketed by outer steel tube with 60 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 100 N/mm². Find the shrinkage pressure and original dimension of the tube. Also plot distribution of stresses due to shrink fit. Take E = 207 KN/mm² **07**

OR

- Q.5** (a) The piston rod of a hydraulic cylinder exerts an operating force of 10 KN. The friction due to piston packing and stuffing box is 10 % of operating force. The pressure in the cylinder is 10 N/mm². The cylinder is made of cast iron FG200 and factor of safety is 5. Determine diameter and thickness of the cylinder. **07**
(b) Explain the different types of end covers of used in pressure vessels. **07**
