

**B.Tech. AEROSPACE ENGINEERING  
(BTAE)**

**Term-End Examination**

00085

**December, 2014**

**BAS-010 : MACHINE DESIGN**

*Time : 3 hours*

*Maximum Marks : 70*

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**Note :** Attempt any **five** questions. All questions carry equal marks. Assume any missing data and clearly specify the assumptions. Use of scientific calculator and design data hand book is permitted.

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1. (a) Explain the term stress concentration. Also write the various methods of mitigation of stress concentration. 6
- (b) A solid circular shaft is subjected to a bending moment of 3,000 N-m and a torque of 10,000 N-m. The shaft is made of 45 C 8 Steel having ultimate tensile stress of 700 MPa and an ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of shaft. 8
2. (a) Enumerate the different types of riveted joints and rivets. 6

- (b) A bracket is welded to the vertical plate by means of two fillet welds as shown in Figure 1. Determine the size of the welds, if the permissible shear stress is limited to  $70 \text{ N/mm}^2$ .

8

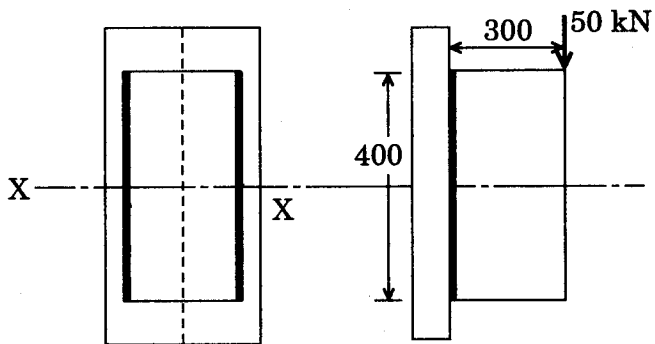


Figure 1

3. (a) Explain notch sensitivity. 6
- (b) In a machine tool application, the tool holder is pulled by means of an operating nut mounted on a screw. The tool holder travels at a speed of  $5 \text{ m/min}$ . The screw has single start square threads of  $48 \text{ mm}$  nominal diameter and  $8 \text{ mm}$  pitch. The operating nut exerts a force of  $500 \text{ N}$  to drive the tool holder. The mean radius of the friction collar is  $40 \text{ mm}$ . The coefficient of friction at thread and collar surface is  $0.15$ . Calculate the power required to drive the screw. 8
4. (a) What is nipping in a leaf spring? Discuss its role. 6

(b) A semi-elliptical leaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full-length leaves and ten graduated length leaves including the master leaf. The centre-to-centre distance between the spring eye is 1.2 m. The leaves are made of steel 55 S; 2 Mo 90 ( $S_{yt} = 1,500 \text{ N/mm}^2$  line spacing and  $E = 207,000 \text{ N/mm}^2$ ) and the factor of safety is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are prestressed so as to equalize stresses in all leaves. Determine :

8

(i) The cross section of leaves

(ii) The deflection at the end of the spring

5. (a) What are the advantages and disadvantages of V-belt drive over flat belt drive ?

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(b) A flat belt is required to transmit 30 kW from a pulley of 1.5 m effective diameter running at 300 rpm. The angle of contact is spread over  $\frac{11}{24}$  of the circumference.

The coefficient of friction between belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. Given that belt thickness = 9.5 mm, density of material =  $1100 \text{ kg/m}^3$  and related permissible working stress = 2.5 MPa.

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6. (a) Explain the causes of gear tooth failure. 6
- (b) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1 : 2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has  $20^\circ$  stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. 8
7. (a) What are rolling contact bearings ? Discuss their advantages over sliding contact bearings. 6
- (b) Design a clamp coupling to transmit 30 kW at 100 r.p.m. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves is six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3. 8
8. (a) Explain the theories used for designing shaft subjected to combined bending and twisting moments. 6
- (b) A single plate clutch consists of only one pair of contacting surfaces. It is used for an engine, which develops a maximum torque of 120 N-m. Assume a factor of safety of 1.5 to account for slippage at full-engine torque. The permissible intensity of pressure is 350 KPa and the coefficient of friction is 0.35. Assuming uniform wear theory, calculate the inner and outer diameters of the friction lining. 8