

**B.Tech. AEROSPACE ENGINEERING
(BTAE)****Term-End Examination****June, 2017****00344****BAS-010 : MACHINE DESIGN***Time : 3 hours**Maximum Marks : 70*

Note : Attempt any **seven** questions. Assume missing data, if any. Use of Machine Design Data Book is allowed. Use of calculator is permitted.

1. (a) What are the basic requirements of machine elements ? Explain. 5
- (b) What do you understand by 'nominal size' and 'basic size' ? Explain with examples. 3
- (c) What do you mean by preferred numbers ? 2
2. The nominal diameter of a triple threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having outer diameter of 100 mm and inner diameter of 65 mm. The coefficient of friction at the thread surface as well as at the collar surface can be taken as 0.15. The screw is used to raise a load of 15 kN. Using the uniform wear theory for collar friction, calculate
 - (a) the torque required to raise the load, and
 - (b) the torque required to lower the load. 10

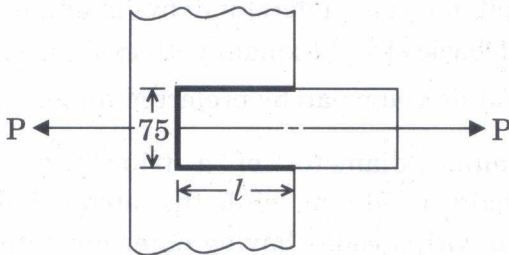
3. A double-riveted double-cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100 mm pitch. The permissible stresses are

$$\sigma_t = 120 \text{ MPa}; \tau = 100 \text{ MPa}; \sigma_c = 150 \text{ MPa.}$$

Find the efficiency of the joint, taking the strength of the rivet in double shear as twice than that of single shear.

10

4. A plate, 75 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds as shown in the figure.



The joint is subjected to a maximum tensile force of 55 kN. The permissible tensile and shear stresses in the weld material are 70 N/mm^2 and 50 N/mm^2 respectively. Determine the required length of each parallel fillet weld.

10

5. A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent load of 3 kN for 10% of time, 2 kN for 20% of time, 1 kN for 30% of time and no load for the remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95% reliability, calculate the dynamic load rating of the ball bearing.

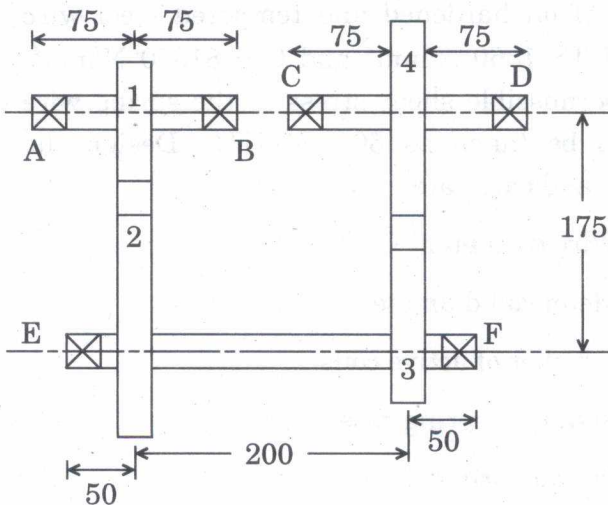
10

6. A helical tension spring is used in the spring balance to measure the weights. One end of the spring is attached to the rigid support while the other end, which is free, carries the weights to be measured. The maximum weight attached to the spring balance is 1500 N and the length of the scale should be approximately 100 mm. The spring index can be taken as 6. The spring is made of oil hardened and tempered steel wire with UTS 1360 N/mm^2 and $G = 81370 \text{ N/mm}^2$. The permissible shear stress in the spring wire should be taken as 50% of UTS. Design the spring and calculate :

10

- (a) Wire diameter
- (b) Mean coil diameter
- (c) Number of active coils
- (d) Required spring rate
- (e) Actual spring rate

7. It is required to design a square key for fixing a gear on a shaft of 25 mm diameter. The shaft is transmitting 15 kW power at 720 rpm to the gear. The key is made of steel 50 C4 [$S_{yt} = 460 \text{ N/mm}^2$] and f.o.s. is 3. For key material, the yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key. 10
8. Design a clamp coupling to transmit 30 kW at 100 rpm. The allowable shear stress for both the shaft and the key is 40 MPa and the number of bolts connecting the two halves are 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. 10
9. The layout of a two-stage gear box is shown in the figure below :



The number of teeth on the gears are as follows :

$$Z_1 = 20; Z_2 = 50; Z_3 = 20; Z_4 = 50$$

Pinion 1 rotates at 1440 rpm in anticlockwise direction when observed from the left side of the paper and transmits 10 kW power to the gear train. The pressure angle is 20° . Draw a F.B.D. of the gear tooth force and determine the reactions at bearings E and F. 10

10. Write short notes on the following : $4 \times 2 \frac{1}{2} = 10$

- (a) Ergonomics Consideration in Design
 - (b) Vibration Effects on Design Considerations
 - (c) Engineering Materials and Properties
 - (d) Tribology
-