

**B.TECH DEGREE EXAMINATIONS: NOV / DEC 2010**

Fifth Semester

**U07ME502: DESIGN OF MACHINE ELEMENTS**

(Common to Mechanical & Mechatronics Engineering)

**Time: Three Hours**

**Maximum Marks: 100**

**Answer All the Questions**

**PART A (10 x 1 = 10 Marks)**

1. Which of the following is to be considered while selecting the material for a machine component?  
A. availability    B. cost    C. mechanical properties    D. all of these
2. The ratio of the highest value of actual stress near discontinuity to the normal stress obtained by elementary equations for minimum cross section is called as  
A. stress concentration factor    B. stress    C. strain    D. young's modulus
3. Which one of the following is a parallel key which is fixed either to the shaft or to the hub and which permits relative axial movement between them  
A. saddle key    B. feather key    C. sunk key    D. woodruff key
4. Which one of the following coupling is used to connect two shafts having intersecting axes?  
A. Oldham's coupling    B. Hooke's coupling    C. muff coupling    D. clamp coupling
5. Pitch diameter is also called as  
A. effective diameter    B. nominal diameter    C. root diameter    D. major diameter
6. Which one of the following welding, the parts are heated to reach the plastic stage and the joint is prepared by impact force  
A. electric resistance welding    B. electric arc welding    C. forge welding    D. gas welding
7. Which one of the following is defined as the axial length of an unloaded helical compression spring  
A. solid length    B. free length    C. compression length    D. helical length
8. A Belleville spring is also called as  
A. extension spring    B. leaf spring    C. torsion spring    D. coned disk spring
9. Which one of the following is the bearing characteristic number?  
A.  $(\mu p / N)$     B.  $(pN / \mu)$     C.  $(\mu N / p)$     D.  $\mu Np$
10. Which type of energy is stored in flywheel ?  
A. kinetic energy    B. kinematic energy    C. potential energy    D. static energy

**PART B (10 x 2 = 20 Marks)**

11. What are the factors to be considered for the selection of material for a machine component?
12. Define: Factor of safety
13. State the maximum shear stress theory
14. What are the advantages of clamp coupling?
15. Name any four types of threaded fastner?

16. List out any two advantages of welded structures over cast iron structures.
17. Name the materials used in springs
18. What are the applications of concentric springs?
19. What are the advantages of oil over grease used as a lubricant?
20. What is the function of the flywheel?

**PART C (5 x 14 = 70 Marks)**

21. a) A wall bracket with a rectangular cross-section is shown in figure 1. The depth of the cross section is twice of the width. The force  $P$  acting on the bracket at  $60^\circ$  to the vertical is 5 kN. The material of the bracket is grey cast iron FG 200 and the factor of safety is 3.5. Determine the dimensions of the cross-section of the bracket. Assume maximum normal stress theory of failure. (All dimensions are in mm)

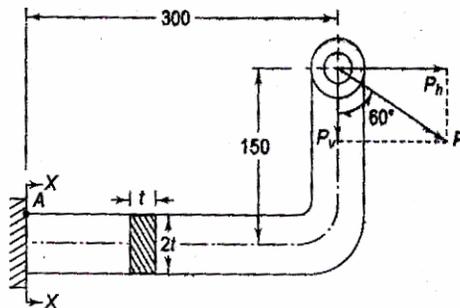


Fig. 1

(OR)

- b) The C-frame of a 100 kN capacity press is shown in figure 2. The material of the frame is grey cast iron FG 200 and the factor of safety is 3. Determine the dimensions of the frame. (All dimensions are in mm)

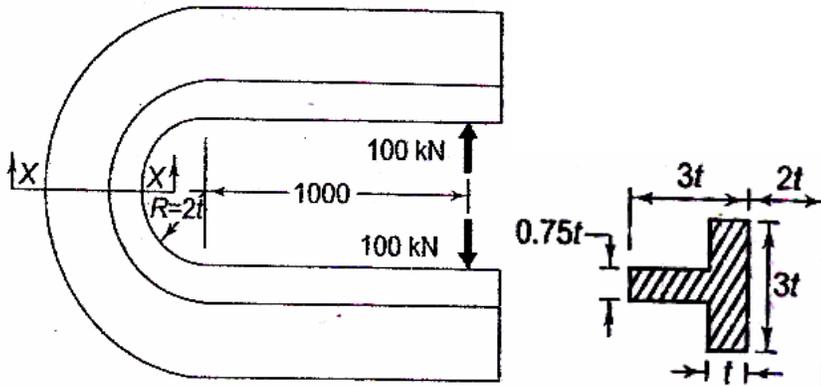


Fig. 2

22. a) A line shaft supporting two pulleys A and B is shown in figure 3. Power is supplied to the shaft by means of a vertical belt on the pulley A which is then transmitted to the pulley B carrying a horizontal belt. The ratio of belt tension on tight and loose sides is 3:1. The limiting value of tension in the belts is 2.7 kN. The shaft is made of plain carbon steel 40C8 ( $S_{ut} = 650 \text{ N/mm}^2$  and  $S_{yt} = 380 \text{ N/mm}^2$ ). The pulleys are keyed to the shaft. Determine the

diameter of the shaft according to the ASME code if,  $k_b = 1.5$  and  $k_t = 1.0$  (All dimensions are in mm)

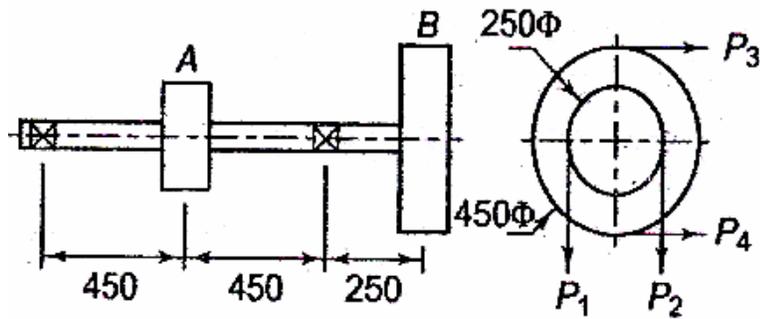


Fig. 3

b) A solid shaft of diameter  $d$  is used in power transmission. Due to modification of the existing system, it is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion. Further, the weight of the hollow shaft per metre length should be half of the solid shaft. Determine the outer diameter of the hollow shaft in terms of  $d$ .

23. a) A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B, as shown in figure 4. Assuming that the bracket is held against the wall and prevented from tipping about the point C by all four bolts and using an allowable tensile stress in the bolts as  $35 \text{ N/mm}^2$ , determine the size of the bolts on the basis of maximum principle stress theory. (All dimensions are in mm)

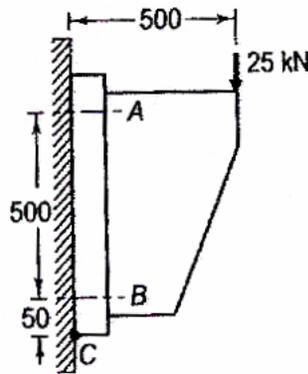


Fig. 4

(OR)

b) A beam of rectangular cross-section is welded to a support by means of fillet welds as shown in figure 5. Determine the size of the welds, if the permissible shear stress in the weld is limited to  $75 \text{ N/mm}^2$  (All dimensions are in mm)

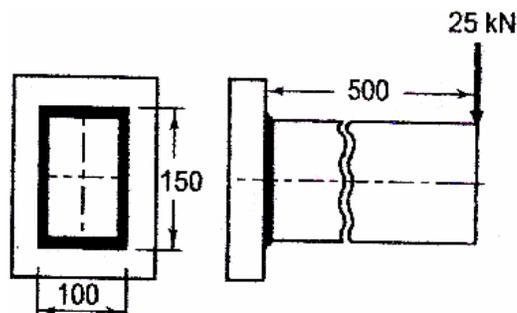


Fig. 5

24. a) It is required to design a helical compression spring for the valve mechanism. The axial force acting on the spring is 300 N when the valve is open and 150 N when the valve is closed. The length of the spring is 30 mm when the valve is open and 35 mm when the valve is closed. The spring is made of oil – hardened and tempered valve spring wire and the ultimate tensile strength is 1370 N / mm<sup>2</sup>. The permissible shear stress for the spring wire should be taken as 30% of the ultimate tensile strength. The modulus of rigidity is 81370 N/mm<sup>2</sup>. The spring is to be fitted over a valve rod and the minimum inside diameter of the spring should be 20 mm. Design the spring and calculate ( i ) wire diameter ( ii ) mean diameter ( iii ) number of active coils ( iv ) total number of coils ( v ) free length of the spring ( vi ) pitch of the coil. Assume that the clearance between adjacent coils or clash allowance is 15% of the deflection under the maximum load.

**(OR)**

b) A concentric spring is used as a valve spring in heavy duty diesel engine. It consists of two helical compression springs having the same free length and same solid length. The composite spring is subjected to a maximum force of 6000 N and the corresponding deflection is 50 mm. The maximum torsional shear stress induced in each spring is 800 N / mm<sup>2</sup>. The spring index of each spring is 6. Assume same material for two springs and the modulus of rigidity of spring material is 81370 N / mm<sup>2</sup>. The diametral clearance between the coils is equal to the difference between their wire diameters. Calculate (i) the axial force transmitted by each spring (ii) wire and mean coil diameters of each spring and (iii) number of active coils in each spring.

25. a) Design a full hydrodynamic journal bearing with the following specification for machine tool applications : Journal diameter is 75 mm, radial load is 10 kN, journal speed is 1440 rpm, minimum oil film thickness is 22.5 microns, inlet temperature is 40<sup>o</sup>, bearing material is Babbitt. Determine the length of the bearing and select suitable oil for this application.

**(OR)**

b) The following data is given for a rimmed flywheel made of grey cast iron FG 200 Mean radius of the rim is 1.5 m, thickness of the rim is 200 mm, width of the rim is 300 mm, number of spokes is 6, cross sectional of each spoke is 10000 mm<sup>2</sup>, speed of rotation is 720 rpm. Calculate (i) the tensile stress in rim at  $\Phi = 30^0$  and  $\Phi = 0^0$  and (ii) the axial stress in each spoke. The mass density of cast iron FG 200 is 7100 kg / m<sup>3</sup>.

\*\*\*\*\*