

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- VIth SEMESTER-EXAMINATION – MAY- 2012****Subject code: 162001****Date: 09/05/2012****Subject Name: Design of Mechanisms-I****Time: 10:30 am – 01:00 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) Explain the classification of loads with examples. **07**
 (b) Write a short note on ' stress concentration'. **07**

- Q.2** (a) Define strength, torsion, stiffness. **07**
 (b) A propeller shaft transmits a twisting moment of 90 KNm ,simultaneous **07**
 bending moment of 30KNm and axial thrust of 125 KN. The shaft is of 350 mm
 external diameter and 250 mm internal diameter. Determine the maximum
 value of the compressive and shear stresses.

OR

- (b) A bolt is subjected to a direct tensile load of 8 KN and a shear load of 4 KN **07**
 .Find suitable size of bolt according to (a) maximum principal stress
 theory(b)maximum shear stress theory(c)strain energy theory.Take factor of
 safety as 3, yield strength as 285 MPa and poisson ratio as 0.3.

- Q.3** (a) Design a right angled bell crank lever to compress a spring(connected to ball **07**
 arm end) by 10 mm. The spring stiffness is 500 N/mm.Ball arm is 200 mm and
 other arm is 500mm. Determine the diameter of the pin .Use following
 data:(a)material of the pin is having allowable shear and bending stress as 40
 MPa and 60 MPa respectively. The lever material has allowable stress as 80
 MPa.(b)the bearing pressure on pin is 10MPa. Assume length of pin is to be
 1.5 times the diameter.
- (b) A hollow CI column of external diameter D and internal diameter 0.7D, 4m **07**
 length and with both the ends fixed supports an axial load of 800KN.Determine
 the section of column if Rankine constants are $a=1/1600$ and crushing
 strength is 550MPa. Take factor of safety as 4.

OR

- Q.3** (a) Design a helical compression spring for an engine valve from following data: **07**
 Maximum load=1500N,Minimum load=1000N,Lift of the valve=5 mm
 Spring index=5,Allowable stress=468 MPa,Modulus of rigidity= 8×10^4 N/mm²
- (b) Design a screw of a screw jack for lifting a load of 160KN and having **07**
 maximum lift of 350mm.Select single start square thread having pitch of
 16mm,core diameter of 59mm,nominal diameter of 75mm and mean diameter
 of 67mm.Take bearing pressure between nut and screw as 12MPa.Friction
 angle as 7 degrees.The yield strength for screw material is 380MPa.The ratio of
 nut height to mean diameter is 2. Factor of safety is 3.5.

- Q.4** (a) A turbine shaft transmits 500KW power at 900 rpm.The permissible shear stress **07**
 is 80 MPa while the twist is limited to 0.5 degree in a length of 2.5m.Calculate
 the shaft diameter.Take $k_t=1.1$, $G=0.8 \times 10^5$ N/mm².If the shaft is chosen hollow
 with $d_i/d_o=0.6$,calculate the percentage saving in material and increase in radial
 dimensions of the shaft.Assume 10% overload.

- (b) What is a toggle jack? How is it designed? Enlist the steps of designing a screw of the toggle jack assuming the required data are available. 07

OR

- Q.4 (a) A machine member of circular section is subjected to moment M and torque T . Show how the diameter d will be designed? Assume the material is known with the related stresses. 07

- (b) An air receiver consisting of a cylinder closed by hemispherical ends has storage capacity of 0.25m^3 and an operating internal pressure of 5 MPa. It is made of plain carbon steel 10C4 ($S_{ut}=340\text{ N/mm}^2$) and the factor of safety is 4. Neglecting the effect of welded joints, find the dimensions of the receiver. Take the length of the cylindrical portion of receiver as twice of the internal diameter of the shell. 07

- Q.5 (a) The spigot and socket joint of cotter type is subjected to an axial load of 80 kN which alternatively change from tensile to compressive. Allowable stresses for the material of all parts are 50, 35 and 90 MPa in tension, shear and crushing respectively. Consider 33% overload due to initial tightening. With neat sketches design the spigot end only. 07

- (b) The fig.1 shows the bracket fixed on a column by means of 3 bolts. Calculate the size of the bolts if the permissible tensile and shear stresses are 75 and 55 MPa respectively. $P=10\text{ kN}$, $e=40\text{ cm}$, $l_1=4\text{ cm}$, $l_2=l_3=40\text{ cm}$ from lower edge of the bracket. 07

OR

- Q.5 (a) Design a shaft with (a) rectangular (b) square key for transmitting 1200 Nm torque to the pulley mounted on it. The permissible stresses for the shaft and key are: 50 and 95 MPa shear and crushing respectively. Consider weakening factor as 0.8 and 25% overload. 07

- (b) What is meant by bolt of uniform strength? Explain with neat sketches. 07

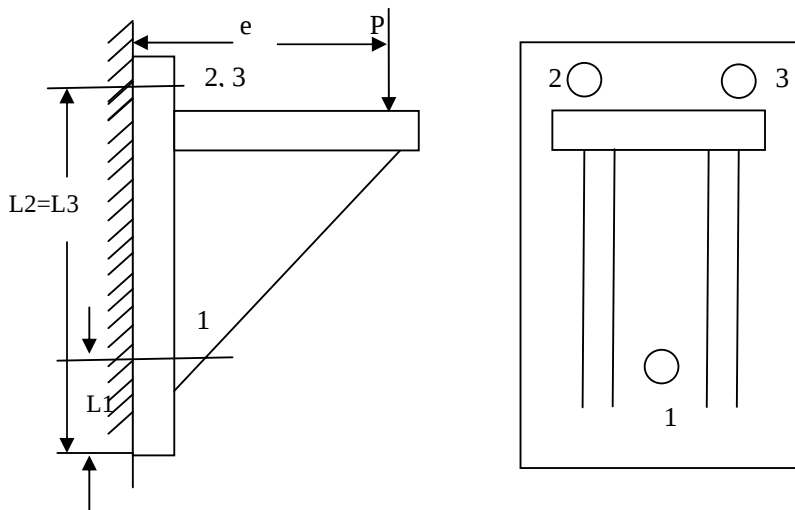


Figure 1: Que. 5 (b)