

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – SUMMER • 2014****Subject Code: 162001****Date: 19-05-2014****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)** Two tie rods are connected by a sleeve using cotters. They are subjected to an axial pull of 50 kN. Design the rod ends and sleeve only using following design stresses. For rods: allowable tensile and shear stress = 60 MPa and 30 MPa, For cotters: allowable crushing stress = 70 MPa, For sleeve: allowable tensile and shear stress = 65 MPa and 45 MPa. The cotters are not to be designed. Consider 33% overload. Support your answer with neat sketch of joint and the resisting areas for various failures. **07**
- (b)** Write a short note on 'Selection of materials' for design. **07**
- Q.2 (a)** Write a short note on factor of safety. **07**
- (b)** A propeller shaft of marine vessel is subjected to an axial load of 3500 N, torque of 6 kN-m and a bending moment of 2.8 kN-m at the critical section. Calculate the diameter of the shaft if permissible stress is to be 120 MPa for the material of the shaft. **07**
- OR**
- (b)** What are the steps of a mechanical design? Explain briefly. **07**
- Q.3 (a)** What is a slenderness ratio? Briefly discuss the end conditions for the column design. Also state and interpret the Euler equation. **07**
- (b)** A long straight tube 76 mm internal diameter and 2.5 mm thick is subjected to an internal pressure of 5.6 MPa. Consider it as a thin cylinder. If the tube is subjected to a twisting moment of 70 Nm and elastic limit stress is 282 MPa, calculate the factor of safety using maximum principal stress theory and maximum shear stress theory. **07**
- OR**
- Q.3 (a)** Briefly explain 'torsion' and 'bending' with related equations and sketch. **07**
- (b)** The bell crank lever of a Hartnell governor has vertical arm (ball arm) of 120 mm length and horizontal arm (sleeve arm) of 100 mm length. The maximum centrifugal force acting on ball arm is 1500 N. Design the lever completely along with the fulcrum pin. The bending stress for lever is 70 MPa and bearing for the pin is 30 MPa. Take the ratio of depth to width as 2 for the lever section of rectangular type. The shear stress for the fulcrum pin is 40 MPa and bending is 80 MPa.
- Q.4 (a)** What are the stresses to be considered for the design of power screw when it is subjected to an axial load and turning moment? Show how a screw and a nut can be designed for the strength with related equations and sketches. **07**
- (b)** A solid shaft is subjected to a bending moment of 3.45 kN-m and torsional moment of 11.5 kN-m. The shaft material has ultimate tensile strength of 690 MPa and factor of safety is 6. Determine diameter of the shaft. **07**

OR

- Q.4 (a)** What are different types of keys used ? How a rectangular key is designed? Explain with neat sketch and related equations. **07**
- (b)** Design a helical compression spring which is to support a load of 550N at 160mm length and a load of 1050 N at 125mm length. The ends are to be close and ground. Take allowable shear stress of 500 MPa, factor of safety as 1.5 and D/d ratio of 7.5. Take $G=8 \times 10^4$ MPa. **07**
- Q.5 (a)** (i) Write a short note on 'Leaf Springs' with neat sketch. **03**
(ii) What are the stresses induced in a thin cylinder subjected to internal pressure? Derive the related equations with neat sketch. **04**
- (b)** A wall bracket carries an inclined load $P=10$ KN at an angle of 30° with vertical as shown in fig.1. The bracket is fixed to the vertical structure by 6 bolts spaced as shown. Calculate the diameter of the bolts if permissible tensile stress is 40 MPa. **07**

OR

- Q.5 (a)** With neat sketch show the procedure for designing a turn buckle assuming the load and stresses are known. **07**
- (b)** Fig.2 shows two views of a cast iron bracket fixed to the steel structure by means of 4 bolts. It carries a vertical load of 35 KN at a distance of 400mm from the center of gravity of the bolts as shown. Calculate the diameter of the bolts if allowable tensile stress is 60 MPa for the bolt material. The distances are $l_1=75$ mm and $l_2=200$ mm. **07**

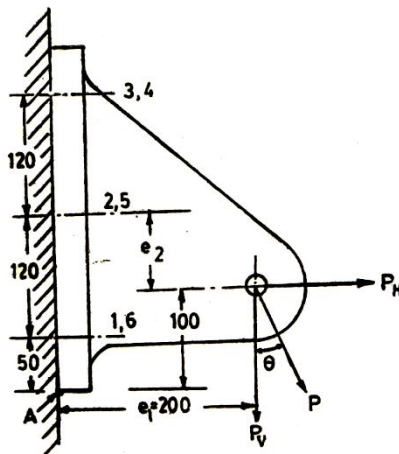


Fig. 1, Q5(b)

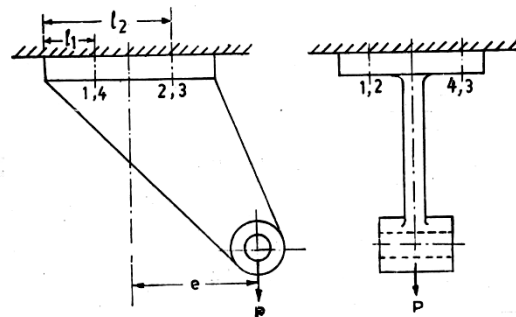


Fig. 2, Q5(b) OR
