GUJARAT TECHNOLOGICAL UNIVERSITY BE – SEMESTER – VI EXAMINATION – WINTER 2015

Subject Code:162001 Subject Name: Design of Mechanisms-I Time:2:30pm to 5:00pm Instructions:

Date:15/12/ 2015

Total Marks: 70

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q. (a) State the considerations based on which a material is selected in the design stage. Also explain 07
 1 in brief the following materials designation with name.(i)Fe 310 (ii) 25C8
 - (b) What is 'stress concentration'? Explain with the neat sketch and example. Also state the 07 remedies.
- Q. (a) A line sketch of a lever of lever loaded safety valve is shown in the Fig.1.The maximum force at 07 which the valve blows is 4 KN. The following permissible stresses could be used. For lever: Permissible tensile and shear stresses are 40 and 25 MPa respectively. For pins: Permissible tensile and shear stresses are 60 and 35 MPa respectively. The allowable bearing pressure is 20 MPa.Design the lever and pins with required neat sketches.Assume rectangular section of lever having depth as thrice the width(maximum).
 - (b) A solid circular steel shaft is encased in a copper hollow shaft so as to make a compound shaft. 07 The diameter of the steel shaft is 8cm and copper shaft is 11 cm. The compound shaft of length 200cm is subjected to an axial torque of 8kNm.Determine (i) maximum shear stress in steel and copper shaft (ii) angular twist per unit length. Take G_{steel}=2G_{copper}=80 GPa

OR

- (b) A lead screw of a lathe has single start trapezoidal threads of 52 mm nominal diameter and 8 07 mm pitch. The screw is required to exert an axial force of 2kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100mm outer diameter and 60mm inner diameter. The values of co-efficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm.Calculate (i) the power required to drive the lead screw (ii) the efficiency of the screw.
- Q. (a) Explain 'factor of safety'. On what basis it is selected? Give examples and discuss. 07
- 3
- (b) A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B as 07 shown in Fig.2.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 35MPa, determine the size of the bolts on the basis of maximum principal stress theory.

OR

- Q. (a) A hollow circular column carries a projecting bracket ,which supports a load of 25KN as shown 07 in Fig.3. The distance between the axis of the column and the load is 500mm. The inner diameter of column is 0.8 times of the outer diameter. The column is made of steel FeE 200(S_{yt}=200 MPa) and factor of safety is 4. The column is to be designed on the basis of maximum tensile stress. The compression is not the criterion of failure. Determine the dimensions of the cross-section of the column.
 - (b) State and explain any three theories of failure.

07

- Q. (a) A transmission shaft supporting a spur gear B and pulley D is shown in Fig.4.The shaft is 11 mounted on two bearings A and C.The diameter of the pulley and the pitch circle diameter of gear are 450mm and 300mm respectively.The pulley transmits 20KW power at 500rpm to gear. P₁ and P₂ are belt tensions in the tight and loose sides.P_t and P_r are tangential and radial components of gear tooth force.Asuume P₁=3P₂ and P_r=P_ttan 20⁰.The gear and pulley are keyed to the shaft .The shaft material has S_{ut}=700 MPa and S_{yt}=460 MPa. The k_b and k_t are 1.5 each.Determine the shaft diameter.
 - (b) Explain preferred numbers and their significance giving example.

OR

- Q. (a) Two mild steel rods are connected by a knuckle joint to transmit an axial load of 150KN.Design 11
 4 the joint completely assuming working stress for both pin and rod material as 80MPa in tension,68MPa in shear and 160 MPa in crushing.The proportions can be taken as follows:t₁=0.75d,t₂=1.25d,h₁=0.5d,d₁=d,d₂=2d,d₃=1.5d,R₁=0.6d,R₂=0.8d,l₁=4d,l₃=1.2d,l₂=4.5d. Show sketches of all failure modes.Refer Fig.5
 - (b) Briefly explain design procedure of a rectangular key with neat sketches.
- Q. (a) A safety valve ,50mm in diameter, is to blow off at a pressure of 1.5MPa.It is held on its seat by means of a helical compression spring, with an initial compression of 25mm. The maximum lift of the valve is 100mm. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire with ultimate strength of 1500MPa and modulus of rigidity of 81370MPa. The permissible shear
 - (b) Briefly discuss any two steps of design procedure with example.

OR

- Q. (a) Explain 'overhauling' and 'self-locking' conditions for design of power screw with related 07
 5 equations.
 - (b) A machine member 0.05m diameter and 0.25m long is supported at one end as a cantilever as 07 shown in the Fig.6.Determine the stresses.

The figures are on next page.

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FIG.5, Q.4 (a) OR