P341

[6003]-422

T.E. (Mechanical /Mechanical Sandwich)
DESIGN OF MACHINE ELEMENTS
### (2019 Pattern) (Semester-I) (302043)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:
1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right side indicate full marks.*
4) *Assume suitable data, if necessary.*

Q1) a) A C-clamp, as shown in Figure, has trapezoidal threads of 12 mm outside diameter and 2 mm pitch. The coefficient of friction for screw threads is 0.12 and for the collar is 0.25. The mean radius of the collar is 6 mm. If the force exerted by the operator at the end of the handle is 80 N, find:

   i) The length of handle;

   ii) The maximum shear stress in the body of the screw and where does this exist; and

   iii) The bearing pressure on the threads. **[8]**
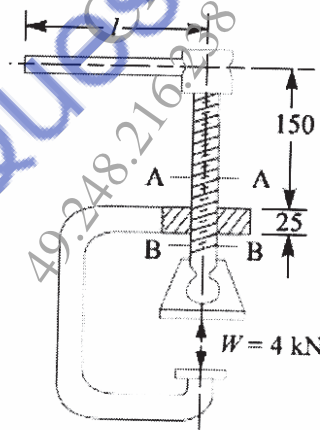
b) Derive expression for torque required to lower the loads in case of square threads. **[5]**

c) What are the different types of screw threads used for power screw? What are the advantages and limitations of power screw? **[4]**

OR

Q2) a) A vertical two start square threaded screw of 100 mm mean diameter and 20 mm pitch supports a vertical load of 18 kN. The nut of the screw is fitted in the hub of a gear wheel having 80 teeth which meshes with a pinion of 20 teeth. The mechanical efficiency of the pinion and gear wheel drive is 90 percent. The axial thrust on the screw is taken by a collar bearing 250 mm outside diameter and 100 mm inside diameter. Assuming uniform pressure conditions, find, minimum diameter of pinion shaft and height of nut, when coefficient of friction for the vertical screw and nut is 0.15 and that for the collar bearing is 0.20. The permissible shear stress in the shaft material is 56 MPa and allowable bearing pressure is 1.4 N/mm². **[8]**

b) Explain self-locking and over-hauling property of screw. Prove the condition for screw to be self-locking. **[5]**

c) Prove that efficiency of self-locking square threads is less than 50%. **[4]**

Q3) a) A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm². The bar is made of steel 40C8 (S_{ut}=600 N/mm²). Calculate the life of the bar for a reliability of 90%. Take surface finish factor 0.44, Size factor 0.85, Reliability factor 0.897. **[8]**

b) What is modifying factor to account for stress concentration? Explain Endurance strength modifying factors? **[5]**

c) Explain with neat sketch the Gerber curve, Soderberg and godman lines? **[5]**

OR

Q4) a) A cantilever beam made of steel material with S_{ut}=550 N/mm², S_{yt}=320 N/mm² as shown in figure is subjected to load which varies from –F to 3F Take surface finish factor 0.89, Size factor 0.85, Theoretical stress concentration factor 1.42, notch sensitivity 0.9, factor of safety 2. Determine miximum value of load F which the cantilever beam can withstand for infinite life. **[8]**
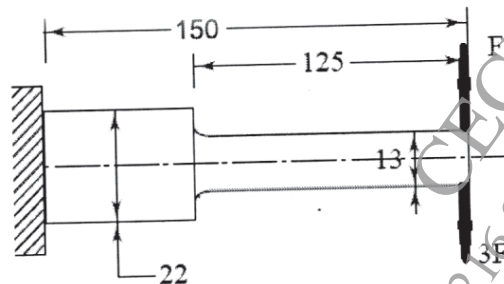
b) Explain modified Goodman diagram. Draw neat labeled sketches of modified Goodman diagram for axial & Bending stresses. **[5]**

c) Explain Fatigue Design under Combined Stresses. **[5]**

Q5) a) A bracket, subjected to a force of 5 kN inclined at an angle of 60° with the vertical, is shown in figure. The bracket is fastened by means of four identical bolts to the structure. The bolts are made of plain carbon steel 30C8 ($S_{yt} = 400$ N/mm²) and the factor of safety is 5 based on maximum shear stress. Assume maximum shear stress theory and determine the size of the bolts. **[8]**
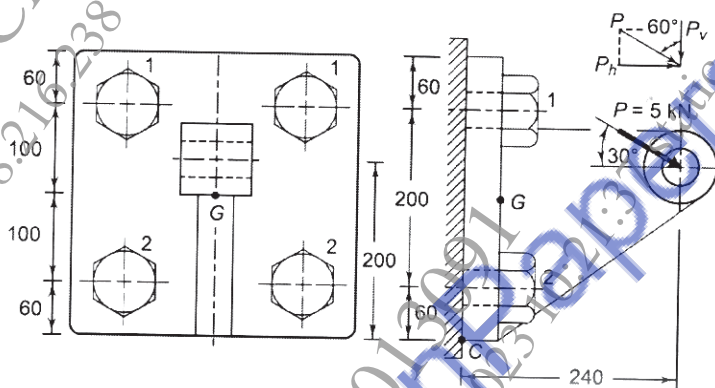
b) Write a note on: Bolts of uniform strength. **[5]**

c) Explain the procedure for the design of bolts for eccentrically loaded bolted joints in shear. **[5]**

OR

Q6) a) Figure shows a welded joint subjected to a load of 20 kN. Find size of weld if permissible shear stress 80 MPa. **[10]**
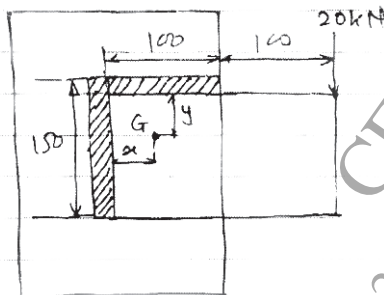
b) Discuss the procedure for designing Axially Loaded Unsymmetrical Welded Sections. **[5]**

c) What are the assumptions made in the design of welded joint? **[3]**

Q7) a) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn. **[8]**

b) What is mean by spring surge and what is its effect? **[5]**

c) Explain with the neat sketch, nipping of leaf spring. **[4]**

OR

Q8) a) Design a helical compression spring with following data; Maximum load=4460 N; Mean coil diameter=85 mm; Maximum shear stress 265 N/mm^2; Spring stiffness= 67 kN/m; G=81.5 kN/mm^2; std wire diameter: 14.5, 15, 15.5, 16, 16.5, 17 (mm). **[8]**

b) Derive the expression for the shear stress induced in a helical compression springs. **[5]**

c) Explain A.M.Wahl's factor and state its importance in the design of helical springs. **[4]**

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