Total No. of Questions : 8]

SEAT No. :

PF5024

[Total No. of Pages : 4

[6626]-162
T.E. (Mechanical)/(Mechanical/S/W)
DESIGN OF MACHINE ELEMENTS
(2019 Pattern) (Semester - V) (302043)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6 and Q7or Q8 from the following.***
2) ***Draw neat labeled diagrams wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of non programmable electronic calculator is permitted.***
5) ***Assume Suitable/Standard data if necessary.***

Q1) a) Derive expression for torque required to raise the loads in case of square threads. **[4]**

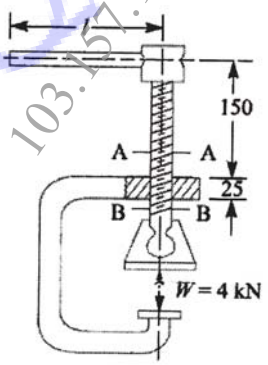
b) Derive the equation for maximum efficiency for power screw? **[5]**

c) 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: **[8]**

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.



OR

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Q2) a) Define power screw and state its applications and advantages. **[4]**

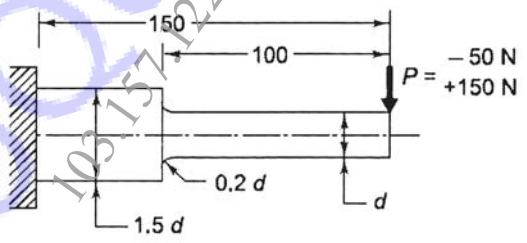
b) Explain self-locking and over-hauling property of screw. Prove the condition for screw to be self-locking. **[5]**

c) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 r.p.m. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2, find: i) the torque required to rotate the screw; ii) the stress in the screw; and iii) the number of threads of nut in engagement with screw. Also state the condition of screw **[8]**

Q3) a) Explain Goodman diagram and Gerber curve. **[4]**

b) What is stress concentration? What are the causes of stress concentration? **[5]**

c) A cantilever beam made of cold drawn steel 40C8 (S_{ut} = 600 N/mm^2 and S_{yt} = 380N/mm^2) is shown in Figure The force P acting at the free end varies from –50 N to +150 N. The expected reliability is 90% and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter of the beam at the fillet cross-section. Take surface finish factor 0.77, Size factor 0.85, Reliability factor 0.897 and theoretical stress concentration factor 1.44. **[8]**



OR

Q4) a) Define and explain Notch Sensitivity.

b) Write a short note on Cumulative damage.

c) A cantilever beam of circular cross section made of steel Fe 550 (S_{ut} =550 N/mm^2 is fixed at one end and subjected to a completely reversed load (P) of 15 kN is at the free end. He force P is perpendicular to the axis of beam. The distance between force to fixed end is 200 mm. Take K_t = 1.35 q = 0.85s, K_a = 0.8,K_c = 0.897, K_b are as follows. The factor of safety is 2. Calculate the diameter d of the beam for infinite life.

d(mm)	d ≤7.5	7.5 < d ≤ 50	d > 50
k_b	1.0	0.85	0.75

Q5) a) List the materials used for **[4]**

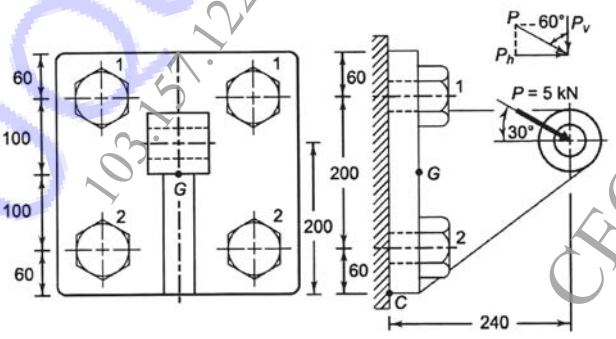
i) Lightly loaded small small bolts, nuts and studs.

ii) High strength bolts

iii) Corrosion resistance threaded fasteners.

b) Write a short note on 'bolts of uniform strength'. **[6]**

c) 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/mm^2) 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]**



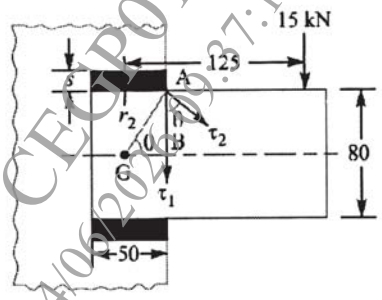
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Q6) a) Prove that stress on the throat is equal to the ratio of force on weld to 0.707×s×l. **[4]**

b) Discuss the procedure for designing Axially Loaded Unsymmetrical Welded Sections. **[6]**

c) A bracket carrying a load of 15 kN is to be welded as shown in Figure. Find the size of weld required if the allowable shear stress is not to exceed 80 MPa. **[8]**



Q7) a) Explain the different types of stress induced in helical spring. **[4]**

b) Derive two basic equations for the design of helical spring. State the importance of Wahl factor in spring design. **[6]**

c) 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]**

OR

Q8) a) What is mean by spring surge and what is its effect? **[4]**

b) Explain with the neat sketch, nipping of leaf spring. **[6]**

c) Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 kN/mm^2. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils. **[8]**