

Total No. of Questions : 8]

SEAT No. :

PB-3899

[Total No. of Pages : 4

[6262]-164

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

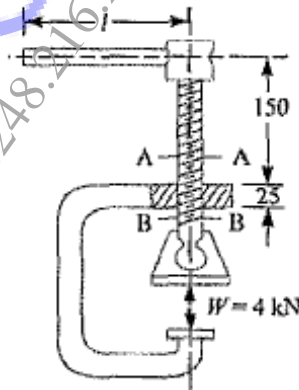
Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and 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 2mm 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 80N, find: 1) The length of handle; 2) The maximum shear stress in the body of the screw and where does this exist; and 3) The bearing pressure on the threads. [8]



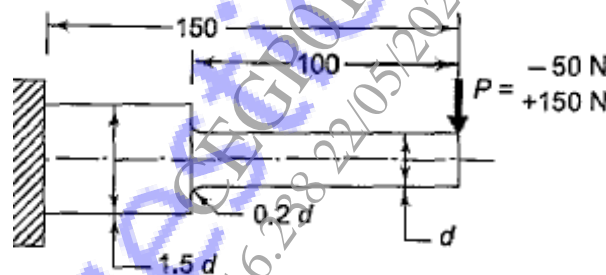
- b) Derive expression for torque required to raise the loads in case of square threads. [5]
- c) Prove that efficiency of self-locking square threads is less than 50%. [4]

OR

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- Q2) a)** 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: 1. the torque required to rotate the screw; 2. the stress in the screw; and 3. the number of threads of nut in engagement with screw. Also state the condition of screw. [8]
- b) Explain with neat sketch, differential screw and Compound screw. [4]
- c) Explain with neat sketch, re-circulating ball screw. State its application. [5]

- Q3) a)** A cantilever beam made of cold drawn steel 40C8 ($S_{ut} = 600 \text{ N/mm}^2$ and $S_{yt} = 380 \text{ N/mm}^2$) is shown in Figure. The force P acting at the free end varies from -50 N to $+150 \text{ N}$. 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]



- b) What is stress concentration? What are the causes of stress concentration? [6]
- c) Define and Explain 1) Notch Sensitivity 2) Endurance limit. [4]

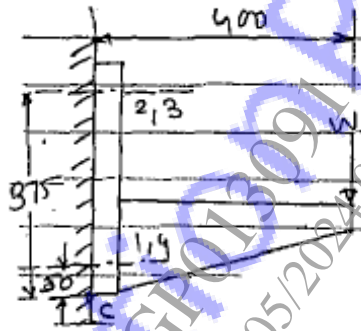
OR

- Q4) a)** A cantilever beam of circular cross section made of steel Fe 550 ($S_{ut} = 550 \text{ N/mm}^2$) is fixed at one end and subjected to a completely reversed load (P) of 15 kN is at the free end. The force P is perpendicular to the axis of beam. The distance between forces to fixed end is 200 mm. Take $K_t = 1.35$, $q = 0.85$, $K_a = 0.8$, $K_c = 0.897$ and the values of K_b is taken from table. The factor of safety is 2 Calculate the diameter of the beam for infinite life. [8]

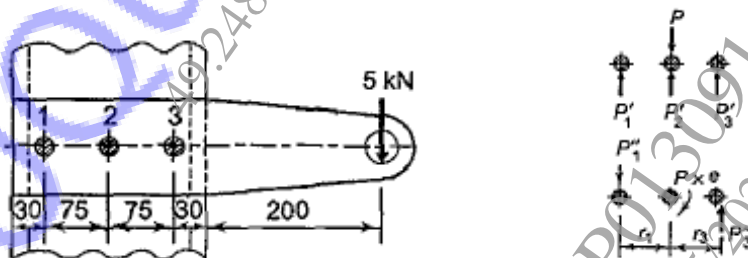
d (mm)	Kb
$d \leq 7.5$	1.0
$7.5 < d \leq 50$	0.85
$d > 50$	0.75

- b) Explain modified Goodman diagram. Draw neat labeled sketches of modified Goodman diagram for axial & Bending stresses. [5]
- c) Write a short note on Cumulative damage. [5]

- Q5) a) A bracket shown in figure is fixed to steel column by means of four bolts of size M14. A load of W acts on the bracket. Take $\sigma_t = 84$ MPa. If ratio B/t for cross section of the arm bracket is 45. Determine 1) Maximum load on bracket, 2) Cross section of bolts. [8]



- b) A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in Figure. The bolts are made from plain carbon steel 45C8 ($S_{yt} = 380$ N/mm²) and the factor of safety is 3. Specify the size of bolts. [5]

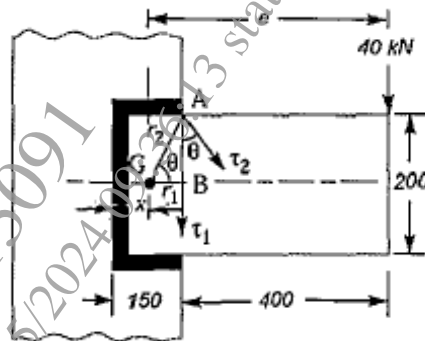


- c) Write a note on: Bolts of uniform strength. [5]

OR

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- Q6) a) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load 40 kN , as shown in Figure. Determine the Maximum shear stress if size of weld is 11.62 mm . [8]



- b) Discuss in brief strength of parallel fillet welds. [5]
- c) Prove that stress on the throat is equal to the ratio of force on weld to $0.707 \times s \times l$ [5]
- Q7) a) A mechanism used in printing machinery consists of a tension spring assembled with a preload of 30 N . The wire diameter of spring is 2 mm with a spring index of 6 . The spring has 18 active coils. The spring wire is hard drawn and oil tempered having following material properties: Design shear stress = 680 MPa ; Modulus of rigidity = 80 kN/mm^2 Determine: 1) the initial torsional shear stress in the wire; 2) Spring rate; and 3) The force to cause the body of the spring to its yield strength. [8]
- b) Draw a neat sketch of a multi-leaf spring and show its essential parts. State functions of any two components. [4]
- c) What is mean by spring surge and what is its effect? [5]

OR

- Q8) a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm^2 . It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm . Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm . The maximum shear stress in the material of the wire is limited to 500 MPa . The modulus of rigidity for the spring material is 80 kN/mm^2 Calculate. 1) Diameter of the spring wire, 2) Mean coil diameter, 3) Number of active turns, and 4) Pitch of the coil. [8]
- b) Explain with the neat sketch, nipping of leaf spring. [5]
- c) Explain A.M. Wahl's factor and state its importance in the design of helical springs. [4]

