P2488

[5253]-506
T.E. (Mechanical)
DESIGN OF MACHINE ELEMENT - I
(2015 Pattern) (End Semester)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

    1) Answer five questions from the following.

    2) Draw neat labeled diagrams wherever necessary.

    3) Figures to right indicate full marks.

    4) Use of electronic calculator is permitted.

    5) Use of Programmable calculator is not allowed.

    6) Assume suitable/standard data if necessary.

Q1) a) Two rods, made of plain carbon steel 40C8 (S_{yt} = 380MPa), are to be connected by means of a cotter joint. The diameter of each rod is 70 mm and the cotter is made from steel plate of 15mm thickness. Calculate the dimensions of the socket end. Use Yield strength in compression = 2x tensile Yield strength, Yield strength in shear = 50% of Tensile Yield Strength and Factor of safety as 6. **[6]**

    b) Define lever. Explain the terms for lever with neat sketch load, effort, load arm, effort arm, mechanical advantage and leverage. **[4]**

<p align="center">OR</p>

Q2) a) Draw neat labeled sketch of protected type flange coupling. **[4]**

    b) A rotating shaft 40mm in diameter, is made of steel FeE 580 (S_{yt}= 580MPa). It is subjected to a steady torsional moment of 250N-m and bending moment of 1250N- m. Calculate the factor of safety available based on (i) Maximum Principal Stress theory and (ii) Maximum Shear stress theory. **[6]**

Q3) a) It is required to design a square key for connecting a sprocket to a 40 mm diameter shaft. 25kW power at 720 rpm is transmitted from the shaft to the sprocket. The key is made from plain carbon steel 30C8 (S_{yt} = 400MPa) and the factor of safety is 4. Assume yield strength in tension and compression is equal. Calculate length of the key on the basis of shear strength and length of key on the basis of compressive strength. **[4]**

<p align="right">P.T.O.</p>

b) A rotating bar made of steel 45C8 (Sut = 630 MPa) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 MPa. Calculate the fatigue strength of bar for a life of 90,000 cycles. Draw necessary SN curve and indicate all parameters.**[6]**

OR

Q4) a) Explain cumulative damage in fatigue with necessary Miner's Equation.**[4]**

b) A rigid flange coupling is required to transmit 20kW power at 720 rpm. The shafts and bolts are made of plain carbon steel 30C8 (Syt = 400 MPa) and the factor of safety is 4. The yield strength in compression is 1.5 times the yield strength in tension. Calculate (i) Diameter of shafts (ii) Flange dimensions and (iii) Diameter of bolts. **[6]**

Q5) 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 the screw collar are 50 mm and 20 mm respectively. The co efficient of thread friction and collar friction are 0.2 and 0.15 respectively. **[12]**

The screw rotates at 12 rpm. Assuming uniform wear conditions at the collar and allowable thread bearing pressure of 5.77 N/mm², find

i) Stresses in the screw.

ii) Torque required to rotate the screw.

iii) Required number of threads of nut in engagement with screw

iv) Power required.

b) Explain Re-circulating ball screw with neat sketch and applications. **[4]**

OR

Q6) a) Prove that for self-locking screw the efficiency is less than 50%. **[3]**

b) The differential screw jack comprising of two non rotating screws with a outside diameter 50 mm. The screw threads are square single start with coefficient of thread friction 0.15. Both the screws are right handed and the lower screw is fixed. The pitch of upper screw is 16 mm and for lower screw is 12 mm respectively. Determine **[13]**

i) Efficiency of the screw jack.

ii) Load that can be lifted if the shear stress in the body of the screw is limited to 28 MPa.

Q7) a) i) What are the advantages of welded joints over a threaded joints. **[6]**

ii) state the various forms of screw thread

b) A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B as shown in figure. Assuming that the bracket is held against the wall and prevented from tipping about C by all four bolts and using allowable tensile stress in bolts as 35 N/mm², Determine the size of bolts on the basis of maximum principal stress theory. **[12]**
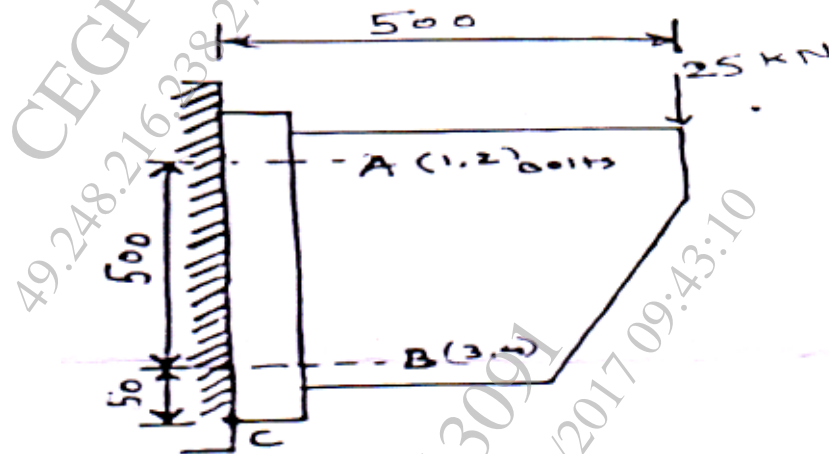
OR

Q8) a) A solid rectangular bar of cross section 80×50 mm is welded by 5 mm fillet weld on all side of flate plate, with axis perpendicular to flat plate. if permissible shear stress for weld is 75 N/mm², Determine the maximum torque that can be applied to the rectangular bar. **[13]**

b) Explain and Draw the neat sketch of Screw fasteners (any two) : **[5]**

i) Through bolt

ii) Tap bolt

iii) Set screw

Q9) a) Define following terms (any two) : **[4]**

i) Solid Length

ii) Spring Rate

iii) Spring Index

b) Design a Closed Coil helical Compression spring for a service ranging from 2250 N to 2750 N. The axial deflection of the spring for load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 Mpa and modulus of rigidity 84×10^3 KN/mm². Neglect the effect of stress concentration. Draw a fully dimensional sketch of the spring showing details. Consider square and ground ends. **[12]**

OR

*Q10)*a) Determine the required number of coils and the allowable deflection in a helical spring made of 1.6 mm determine wire. Assume the spring index as 6 and permissible shear stress as 345 N/mm². The stiffness of spring is to be 1.2 N/mm Take G = 80 Gpa. Assume Square and Ground ends. **[8]**

b) i) Explain Leaf spring with neat sketch **[8]**

ii) What is meant by spring surge & explain its effect?

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