Total No. of Questions : 10]

SEAT No. : ____

P1694

[Total No. of Pages : 4

[5460]-511
T.E. (Mechanical Engg.)
DESIGN OF MACHINE ELEMENTS - I
(2015 Pattern)

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

Instructions to the candidates:

1) ***Answer five questions from the following.***
2) ***Draw neat labelled 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) Draw neat sketches of three types of levers depending upon the position of effort point, load point and the fulcrum. Mention the applications of each. **[4]**

b) Two rods made of plain carbon steel are to be connected by means of cotter joint. Each rod diameter is 55 mm and the cotter is made from a steel plate of 20 mm thickness. Calculate the dimensions of socket end if the permissible tensile & permissible compressive stresses are 65MPa and 130 MPa respectively. The permissible shear stress is 32 MPa. The factor of safety for the joint is 3. **[6]**

OR

Q2) a) A rigid coupling is used to transmit 25kW power at 815 rpm. There are six bolts and the pitch circle of the bolts is 135 mm. The bolts are made of plain carbon steel of yield strength of 400 MPa and the factor of safety is 2.5. Assuming that bolts are finger tight and reamed in ground holes evaluate the diameter of bolts. **[6]**

b) Considering the torque transmitting capacity, arrange the following keys in chronological order ranging from low torque transmission to high torque transmission. The keys are Sunk, hollow saddle and flat saddle keys. State the reason for chronological arrangement. **[4]**

P.T.O.

Q3) a) Draw neat labelled sketches for stress-time relationships for mathematical models of i) Alternating stresses ii) Repeated stresses iii) Reversed stresses. Explain the notations used. **[4]**

b) A solid machine shaft 50mm in diameter transmits a torsional moment of 1200 N-m. A square key is used whose one side is equal to $l/4^{th}$ the shaft diameter and length is 1.5 times the shaft diameter. Evaluate the key dimensions and check the key for its induced shear and crushing stresses. Obtain the factor of safety for key in shear and crushing when yield stresses in shearing and crushing are 350N/mm^2 and 425 N/mm^2 respectively. **[6]**

OR

Q4) A forged steel bar; 45mm diameter is subjected to a reversed bending stress of 300N/mm^2. The ultimate tensile strength of the steel material is 600MPa. Calculate the life of bar for a reliability of 90%. Use surface finish factor as 0.45, temperature factor as 0.25. **[10]**

Q5) a) Enlist any four applications of ball bearing screw. **[4]**

b) The lead Screw of lathe has single start I.S.O metric trapezoidal threads of 50mm nominal diameter and 6 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 out on a collar of 100 mm outer diameter and 60 mm inner diameter. The values of coefficient of friction at thread surface and collar surface is 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm. Calculate **[12]**

i) Power required to drive the lead screw

ii) Efficiency of Screw

OR

Q6) a) What is the fundamental difference between the force acting on square and trapezoidal threads, explain with neat sketch? For trapezoidal threads, what will be the effective coefficient of friction? **[4]**

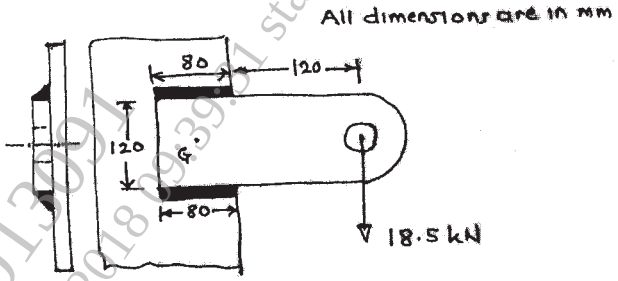
b) The nominal diameter of triple threaded screw is 60 mm while the pitch is 8mm. The screw is used to raise a load of 15 kN. It is used with collar having outer diameter 100 mm and inner diameter 65 mm. The coefficient of friction at thread surface & collar surface is 0.15. Assuming uniform Pressure theory for collar friction determine **[12]**

i) Torque required to lift the load

ii) Torque required to lower the load

iii) Force required lifting the load if it is applied at a radius of 600mm

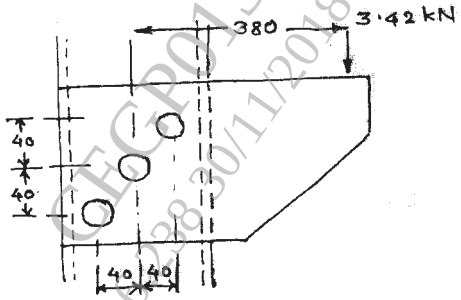
Q7) a) A welded connection as shown in figure is subjected to an eccentric force of 18.5 kN. Determine the size of the weld, if the permissible shear stress in the weld is limited to 90 MPa. Assume static condition. **[12]**



b) For a gear box assembly, a steel eye bolt is provided for lifting and transportation on shop floor. The bolted joint is subjected to tensile force P. Derive an equation for height of nut in this bolted assembly if 'd' is nominal diameter, 'd_c' is core diameter of bolt and 'h' is height of nut. **[6]**

OR

Q8) a) A steel plate subjected to a force of 3.42 kN and fixed to a channel by means of three identical bolts as shown in the figure. The bolts are made of plain carbon steel having yield strength of 450 MPa. If the factor of safety is 2.5, calculate the size of bolts. **[12]**



b) A shaft of circular cross-section is welded to the plate by means of circumferential fillet weld. The shaft is subjected to the torsional moment 'M_t' which induces the torsional shear stresses in the weld. Derive an expression for torsional shear stresses induced in the circumferential weld. Assume shaft diameter as 'd'. **[6]**

Q9) a) Name and draw the neat labelled sketch of suspension spring used trucks. **[4]**

b) It is required to design a helical compression spring for the valve mechanism. The axial force acting on the spring is 300 N when the valve is open and 150 N when the valve is closed. The length of the spring is

30 mm when the valve is open and 35 mm when the valve is closed. The spring index is 6. The spring is made of cold-drawn steel wire with ultimate tensile strength of 1400 N/mm^2. The permissible shear stress for spring wire should be taken as 30% of the ultimate tensile strength. The modulus of rigidity is 81370 N/mm^2. Design the spring and calculate:

i) Wire diameter
ii) Mean coil diameter
iii) Number of active coils
iv) Total number of coils
v) Free length of the spring and
vi) Pitch of the coil

Assume that total clearance is 15% of the deflection under the maximum load. **[12]**

OR

Q10) a) A helical compression spring is used to absorb the shocks. The initial compression of the spring is 30 mm and it is further compressed by 50 mm while absorbing the shock. The spring is to absorb 250 J of energy during the process. The spring index can be taken 6. The spring is made of cold drawn steel wire with ultimate tensile strength of 1100 N/mm^2. The permissible shear stress for the spring wire should be taken as 50 % of the ultimate tensile strength. The modulus of rigidity is 81370 N/mm^2. Design the spring and calculate: **[12]**

i) Wire diameter
ii) Mean coil diameter
iii) Number of active coils
iv) Total number of coils
v) Free length of spring; and
vi) Pitch of the coils

Assume that the total clearance is 15% of the deflection under the maximum load.

b) What is surge in springs? Enlist methods to avoid surge in springs. **[4]**