Total No. of Questions : 10]

SEAT No. :

P2922

[Total No. of Pages : 5

[5669]-511

T.E. (Mechanical Engineering)

DESIGN OF MACHINE ELEMENTS - I

(2015 Pattern) (Semester - I)

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

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
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 transmission shaft of circular cross-section is subjected to bending moment 'M' and torsional moment 'T'. If the maximum permissible shear stress in the shaft is given by τ_{max}, show that the diameter 'd' of the shaft is given by **[6]**

$$d^3 = 16 / \Pi . \tau_{max} \sqrt{M^2 + T^2}$$

b) Enlist the factors influencing the magnitude of factor of safety. **[4]**

OR

Q2) A protected type flange coupling is used to transmit 25 kW power at 500 rpm from an engine to a machine. Design the coupling for an overload capacity of 25 %. Assume following permissible stresses : **[10]**

	C.I. (Flange)	M.S. (Shaft & Key)	Plain Carbon Steel (Bolt)
Permissible tensile stress (N/mm^2)	20	60	60
Allowable shear stress (N/mm^2)	12	35	28
Allowable compressive stress (N/mm^2)	60	60	60
Number of bolts	6		

P.T.O.

Q3) A shaft section where the diameter changes from 430 mm to 300 mm, a fillet radius of 7.5 mm is provided. This section is provided to a constant bending moment of 470 kNm. Following data may be assumed : **[10]**

Yield strength of shaft material = 350 MPa

Endurance limit of specimen = 210 MPa

Notch sensitivity = 0.8, Size factor = 0.75

Surface finish factor = 0.8, Ultimate tensile strength = 500 MPa

Factor of safety = 1

Table for theoretical stress concentration factor (K_t) is :

r_j/d	0.025	0.05	0.1
K_t	2.6	2.05	1.66

Where, r_j is fillet radius and d shaft diameter. Determine the expected life of the shaft.

OR

Q4) A machine component made of steel (Sut = 630 MPa) has a rectangular cross-section 50 mm × 10 mm. It is subjected to a completely reversed axial force of 'P' N. Expected reliability is 90% and corresponding factor is 0.89. Factor of safety is 2. Following factors can be assumed: Surface finish factor = 0.8, Notch sensitivity = 0.8, Size factor = 0.85, Theoretical Stress Concentration factor = 2.25. Find the force 'P' corresponding to infinite life expectation. What will be the maximum force if the expected life is only 50000 cycles. **[10]**

Q5) a) How does the helix angle influence the efficiency of square threaded screw. What are the various types of screw threads used for power screws? **[4]**

b) A 26 × 5 square threaded, single start power screw is used to support a load of 12 kN. The effective diameter of the collar is 46 mm and the coefficient of friction is 0.15. The nut is made of phosphor bronze having 0.12 as coefficient of friction and 6 MPa as allowable bearing pressure. The length of the handle is 300 mm. Calculate: **[12]**

i) The force required to raise the load

ii) The force required to lower the load

iii) The yield strength of material for a factor of safety of 4

iv) The overall efficiency of the screw

The number of threads in nut.

OR

Q6) a) Compare between square thread, Vee threads, Trapezoidal threads and Buttress threads on the following basis: - Manufacturing, Strength. Efficiency, Applications. **[4]**

b) A triple - threaded power screw, used in a screw jack has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square and the length of nut is 48 mm. The screw jack is used to lift a load 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate **[12]**

i) The maximum shear stress in the screw body.

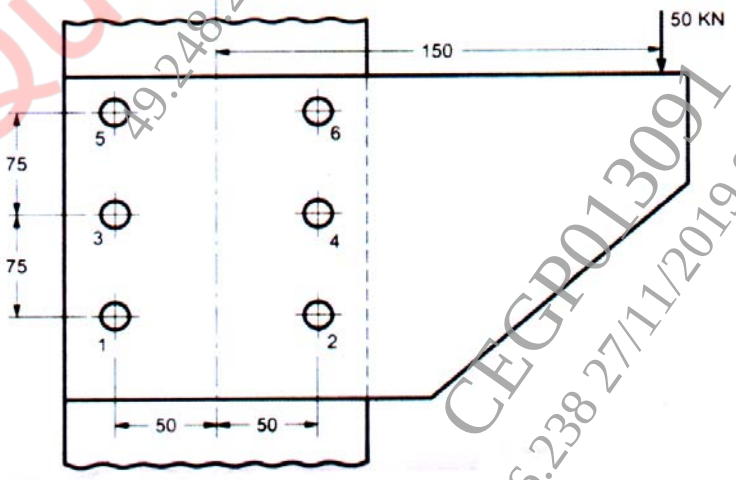
ii) The direct shear stress in the screw and the nut and

iii) The unit bearing pressure.

State weather the screw is self-locking.

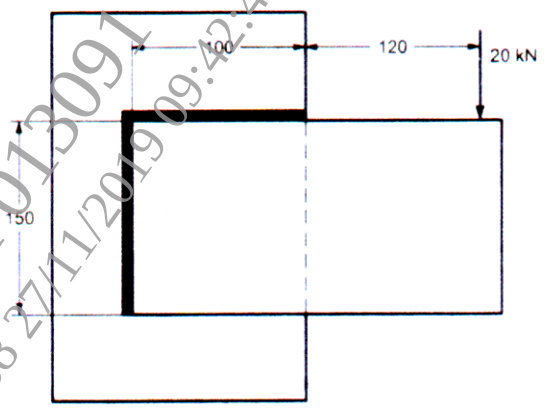
Q7) a) What is Preloading of bolts? State its advantages. Give two applications of preloading of bolts. **[4]**

b) A bracket is bolted to column by 6 bolts of equal size as shown in fig. It carries a load of 50 kN at the distance of 150 mm from the centre of column. If the maximum stress in the bolts is to be limited to 150N/mm^2. Determine the core diameter of bolts. **[14]**



OR

Q8) Fig. shows a welded joint subjected to an eccentric load of 20 kN. The welding is only on one side. If the permissible shear stress for the weld is 80 MPa, determine the weld size. **[18]**



Q9) a) Explain shear stress correction factor 'K_s' and Wahl factor 'K_w' for design of helical spring. When do you use them. **[4]**

b) It is required to design a valve spring of IC Engine with following details:

Spring load = 80 N, When valve is closed

Spring load = 100 N, When valve is open

Space constraints for spring fitment are :

Inside guide bush diameter = 24 mm

Outside recess diameter = 36 mm

Valve lift = 5mm

Spring steel has following properties :

Ultimate tensile strength = 700 N/mm^2

Modulus of rigidity = 8.4×10^4 N/mm^2

Spring ends are square and ground. Permissible shear stress for spring wire = 0.5 Sut. Determine: Wire diameter, Spring index, Total number of coils . Solid length, Free length. Pitch of the coil when additional 15 % of working deflection is used to avoid complete closing of coil. **[12]**

OR

Q10)a) Compare the stiffness of two springs in series and with two springs in parallel. **[4]**

b) A loaded narrow gauge rail car weighing 2000 kg mass and moving at 4.32 km/hr velocity is brought to rest by a bumper consisting of two helical compression springs of spring index 6. In bringing the rail car to rest, both the bumper springs get compressed by 140 mm. The spring steel has permissible shear stress of 400 N/mm^2 and the modulus of rigidity is 84000 N/mm^2. Determine the greatest load on each spring, the diameter of spring wire , mean coil diameter, number of coils and the free length of the spring. **[12]**

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