Total No. of Questions : 10]

SEAT No. : ____

P2399

[Total No. of Pages : 4

[5253]-111

T.E. (Mechanical) (Semester - I)

DESIGN OF MACHINE ELEMENTS - I

(2012 Pattern)

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, and mention it clearly.***
5) ***Use of Electronic Pocket calculator is allowed.***

Q1) a) Define "design of machine element". Explain any four general considerations for design of machine elements. **[6]**

b) A factory line shaft is to transmit 75 kW at 200 rev/min. The maximum allowable twist is 1 degree in a length of 20 diameters. Determine the required shaft diameter. Take G = 84 GPa. **[4]**

OR

Q2) a) Two rods are connected by means of a cotter joint. The inside diameter of socket and outside diameter of socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 (S_{yt} = 400N/mm^2) and factor of safety is 4. The width of cotter is five times of thickness. Calculate: **[6]**

i) Width and thickness of the cotter on the basis of shear failure; and

ii) Width and thickness of the cotter on the basis of bending failure.

b) Explain design of shafts based on **[4]**

i) Torsional rigidity

ii) Lateral rigidity.

P.T.O.

Q3) a) Suggest suitable coupling in the following cases: **[2]**

i) Precise alignment between two shafts.

ii) Shafts having intersecting axes.

b) A machine component is subjected to a flexural stress which fluctuates between +300 MN/m^2 and -150 MN/m^2. Determine the value of minimum ultimate strength according to **[8]**

i) Geber relation

ii) Soderberg relation

iii) Modified Goodman relation

Take yield strength = 0.55 Ultimate strength,

Endurance strength = 0.5 Ultimate strength and factor of safety = 2.

OR

Q4) a) What are the criteria to use splined shafts? Give any two applications of splined shaft. **[2]**

b) A rotating bar made of steel 45C8 (S_{ut} = 630 N/mm^2) is subjected to completely reversed bending stress. The corrected endurance limit of bar is 315 N/mm^2. Calculate the fatigue strength of the bar for a life of 90,000 cycles. **[8]**

Q5) a) How does the helix angle and coefficient of friction influence on the efficiency of square threaded screw? **[4]**

b) The lead screw of a lathe is of Acme threads with outside diameter 52 mm and pitch of 8 mm. in order to drive the tool carriage, the screw must exert an axial force of 2200 N. The axial thrust is carried on a collar with 30 mm inner and 60 mm outer diameter. The coefficient of friction between the lead screw and split nut is 0.15, and that for collar bearing is 0.12. **[12]**

i) Determine the power required to drive screw at 40 rpm.

ii) What is the efficiency of the lead screw?

OR

Q6) a) State what types of screw threads will you select for following applications giving reasons and also show the thread forms. **[6]**

i) Lathe lead screw

ii) Screw jack

iii) Machine vice

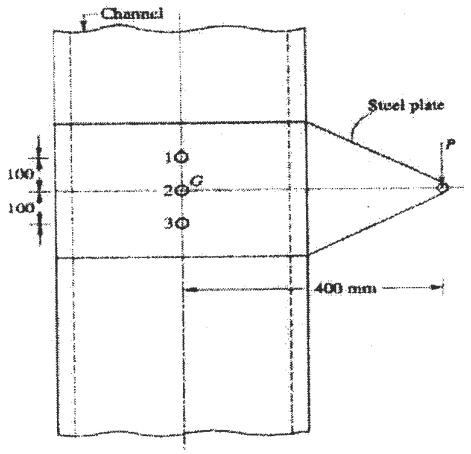
b) In a bench vice, the screw has a double start square thread of 25 mm nominal diameter in a coarse pitch series. The length of lever is 250 mm, and a force of 392.4 N is applied at the end of the lever. If the coefficient of friction between the screw and nut is 0.14, what is the force on job through jaws? State screw is overhauling or not? **[10]**

Q7) a) Derive the relation for **[6]**

i) Strength of parallel fillet weld

ii) Strength of single transverse fillet weld

b) Three M20 bolts are used to connect a steel plate with channel section structural member, as shown in figure. The material of the bolt is 50C4 with S_{yt} = 530.80MPa. Factor of safety is 2.0. How much eccentric load (P) can be carried by the steel plate? **[10]**



Figure

OR

Q8) a) Discuss the bolt of uniform strength with neat sketch. **[6]**

b) A solid rectangular bar of cross-section 80 mm (horizontal) by 50 mm (vertical) is welded by a 5 mm fillet weld on all sides to a flat plate, with axis perpendicular to the plate surface. Find the maximum torque that can be applied to the bar, if the shear stress in the weld is not to exceed 85 N/mm^2. **[10]**

Q9) a) i) Under what conditions is the use of concentric springs recommended? Give two practical examples.

ii) Under what conditions a leaf spring is preferred over a coil spring? Give two practical examples.

[8]

b) A bumper, consisting of two helical steel springs of circular section, brings to rest; a railway wagon of mass 1500 N, and moving at 1.2 m/s. While doing so, the springs are compressed by 150 mm. The mean diameter of coils is 6 times the wire diameter. The permissible shear stress is 400 MPa. Determine **[10]**

i) Maximum force on each spring.
ii) Wire diameter of the spring
iii) Mean diameter of coils
iv) Number of active coils

Take $G = 0.84 \times 10^5$ MPa

OR

Q10)a) What are objectives of series and parallel connections of springs? Derive the relation for spring stiffness when springs in series and parallel. **[8]**

b) A concentric spring is subjected to a load of 12.67 kN. Inner spring is 13 mm shorter than outer spring. Find the stress developed inside both the springs using following data : **[10]**

Description	Outer spring	Inner spring
Outside diameter of coil of spring (mm)	180	90
Number of active turns	8	14
Wire diameter (mm)	20	10
Modulus of rigidity (MPa)	81550	80335