Total No. of Questions : 10]

SEAT No. :

P3248

[Total No. of Pages : 7

[5353] - 111
T.E. (Mechanical)
DESIGN OF MACHINE ELEMENTS - I
(2012 Pattern) (Semester - I)

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

Instructions to the candidates:

1) ***Neat diagram must be drawn wherever necessary.***
2) ***Assume suitable data if necessary.***
3) ***Figures to the right indicate full marks.***

Q1) a) Define the term 'draw' of the cotter. State the assumptions made in the design of cotter joint and discuss in brief modes of failure of the elements in cotter joint. **[6]**

b) What is standardization? State the standards used in specifying (any three) **[4]**

i) Materials, chemical composition, mechanical properties & heat treatments.

ii) Shapes & dimensions of commonly used machine elements.

iii) Fit, tolerances & surface finish.

iv) Testing of products.

OR

Q2) a) Discuss an applicability of **[4]**

i) Saddle keys

ii) Sunk keys

iii) Feather key

iv) Woodruff key

b) A cantilever beam is loaded as shown in fig. 2 (b) below. Ultimate tensile strength and yield strength in tension for the beam material are 0.6 GPa and 0.38 GPa respectively. Load F varies from - 50 N to +150 N. Take factor of safety as 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter 'd' of the beam at the fillet cross-section using Gerber parabola as failure criteria. **[6]**

P.T.O.

Use $K_a = 0.77$

$K_b = 0.85$

$K_c = 0.897$

$K_t = 1.44$ (at fillet section)

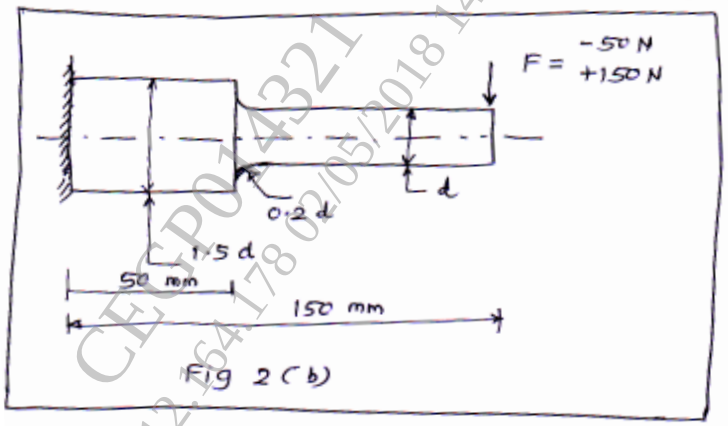

Fig 2 (b)

Q3) a) What is coupling? Discuss the requirements, the good coupling should satisfy. State the applicability of **[4]**

i) Rigid coupling

ii) Flexible coupling

iii) Oldham coupling

iv) Hooke's coupling

b) A solid shaft of diameter D is used to transmit power. It is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion due to modification of the existing transmission system. The weight of the hollow shaft per meter length should be half of the solid shaft. Determine the outer diameter of the hollow shaft in terms of 'D'. **[6]**

OR

Q4) a) A steel bar 50 mm in diameter is subjected to a reversed bending stress of 250 N/mm^2. The bar material is 40 C 8 for which σ_{ut} = 0.6 GPa. Calculate the life of bar for a reliability of 90%.

Use : $K_a = 0.44$

$K_b = 0.85$

$K_c = 0.897$ **[6]**

b) State the material grades of alloy steels used for making transmission shafts. Discuss the maximum shear stress theory used to determine the outer diameter of the hollow shaft. **[4]**

Q5) a) State and explain various forms of threads, with their advantages & disadvantages. **[6]**

b) Derive an equation for efficiency of the trapezoidal threads. **[4]**

c) The tool holder is pulled by means of an operating nut mounted on a screw in a machine tool application.

The travel of tool holder at a (speed) = 5 m/min.

The screw has single start square threads of 48 mm nominal diameter and 8mm pitch.The operating nut exerts a force of 0.5 kN to drive the tool holder.

The mean radius of the friction collar is 40mm. The coefficient of friction at thread and collar surfaces is 0.15. Calculate **[8]**

i) Total torque required

ii) The rpm of screw

iii) Power required to drive the screw

iv) Overall efficiency of the mechanism.

OR

Q6) a) Derive an equation for maximum efficiency of square threaded screw. Also discuss the factors on which the efficiency depends. **[8]**

b) It is required to design a double - start screw with square threads for the C - clamp as shown in fig. 6 (b). The maximum force exerted by the clamp is 5000N. **[10]**

i) Operator force a the ball handle of the hand wheel = 250N

ii) σ_{yt} of screw material = 330 N/mm^2

iii) σ_{ut} of nut material = 200 N/mm^2

iv) Factor of safety = 2

v) Collar inner diameter = 6 mm

Collar outer diameter = 17 mm

vi) Coefficient of friction at screw = 0.15

vii) Coefficient of friction at collar = 0.17

viii) Unit bearing pressure between nut & screw = 15 N/mm^2

Determine i) Stresses at section A – A & B – B

ii) Length of nut

iii) Total torque required

iv) Radius of ball handle (R_m)

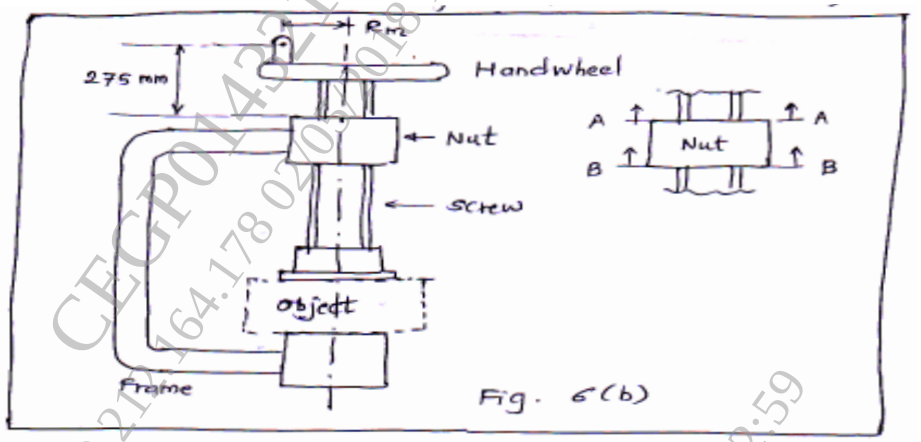

Fig. 6(b)

Q7) a) 'Thread rolling is superior to thread cutting' . Explain **[4]**

b) Explain the failure of transverse fillet weld. **[4]**

c) A rigid bracket subjected to a vertical force of 10kN is as shown in Fig. 7(c). It is fastened to a vertical wall by means of four identical bolts. Determine the bolt sizes by maximum shear stress theory .The maximum permissible shear stress in any bolt is limited to 50 MPa. (Refer Table 1)

Table 1: Basic dimensions for ISO metric screw Threads (Coarse series)

Designation	Nominal dia. (mm)	Pitch P (mm)	Pitch dia. (mm)	Minor dia. dc(mm)	Tensile stress area (mm^2)
M10	10	1.50	9.026	8.160	58.00
M12	12	1.75	10.863	9.853	84.30
M16	16	2.00	14.701	13.546	157.00
M20	20	2.50	18.376	16.933	245.00

[8]

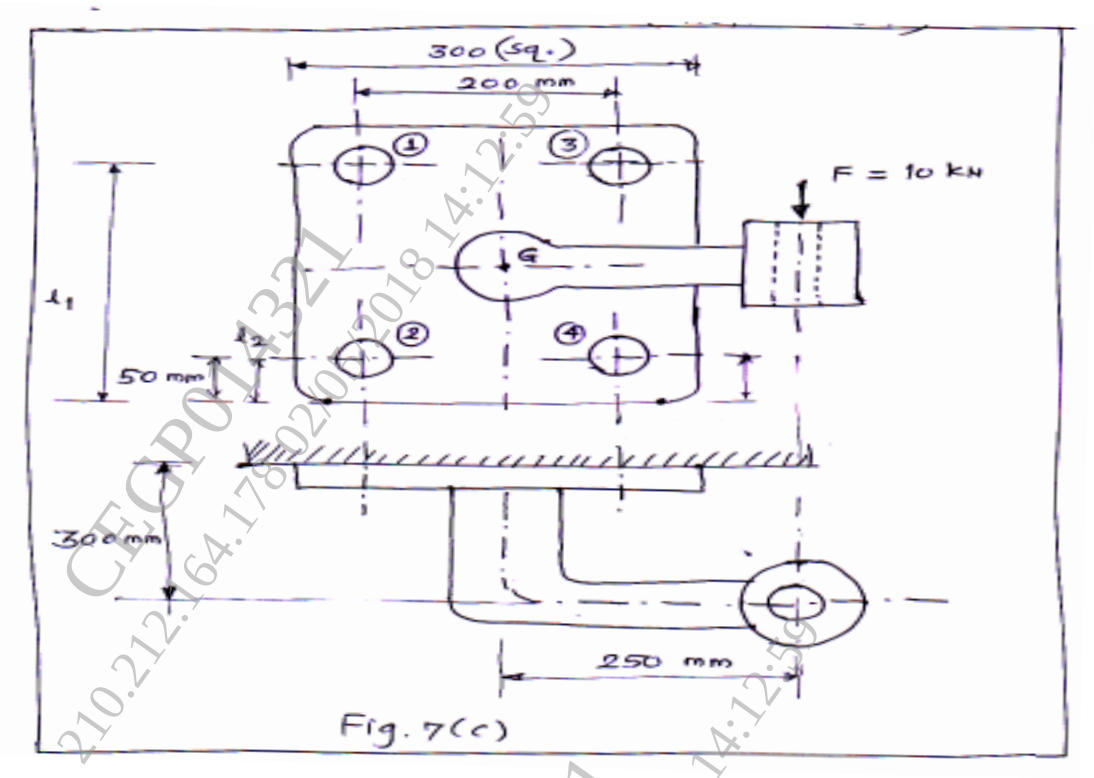

Fig. 7(c)

OR

Q8) a) Explain the design of bolted connection subjected to eccentric load perpendicular to axis of bolt. **[6]**

b) State the types of butt joints. **[2]**

c) A welded connection as shown in fig. 8(c) is subjected to an eccentric force of 60kN in the plane of the welds. Determine the size of the welds, if the permissible shear stress for the weld is 100 MPa. Assume static conditions. **[8]**

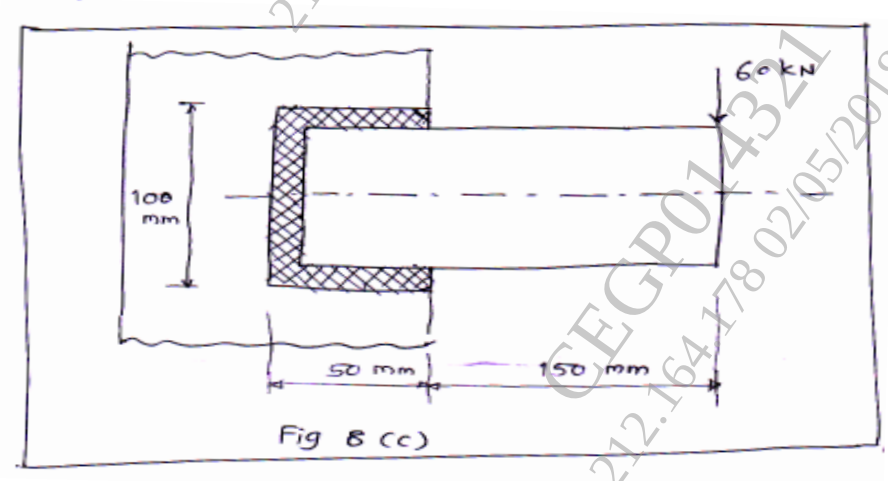

Fig 8 (c)

Q9) a) Explain following terms **[4]**

i) Spring index

ii) Free length of spring

iii) Spring stiffness

iv) Stress factor

b) State the objectives of series and parallel combinations of springs. **[4]**

c) It is required to design a helical compression spring subjected to a maximum force of 1250 N. **[8]**

- The deflection of spring (Corresponding to maximum force) = 30mm
- Spring index = 6
- Spring wire material : Patented & cold drawn steel wire.
- Ultimate tensile strength of spring material = 1.09 GPa
- Modulus of rigidity of spring material = 81.37 GPa
- Permissible shear stress for spring wire = 50% of σ_{ut}

Calculate

i) Wire diameter

ii) Mean coil diameter

iii) Number of active coils

iv) Total number of coils

v) Free length of spring

vi) Pitch of the coils

Draw sketch of spring with dimensions

OR

Q10)a) Explain the phenomenon of 'Surge' in spring with an example. Also discuss the ways to avoid surge. **[4]**

b) Discuss the phenomenon of pre - stressing leaves of leaf spring. State it's importance. **[4]**

c) A single plate clutch consists of two pairs of friction surfaces, one between the friction lining and the pressure plate and the other between the friction lining and the flywheel as shown in the Fig. 10(c). Eight identical helical compression springs, arranged in parallel, provide the required axial thrust on the friction surface. The total spring force exerted by all the springs is 2.4 kN and the corresponding deflection of each spring is approximately 15mm.The spring index can be taken as 8. The spring material is patented and cold drawn steel wire with ultimate tensile strength of 1.39 GPa and modulus of rigidity of 81.37 GPa. The permissible shear stress for the spring is 30% of the ultimate tensile strength. Calculate **[8]**

i) Wire diameter
ii) Mean coil diameter
iii) Number of active coils
iv) Total number of coils
v) Solid length
vi) Free length
vii) Pitch of the coil
viii) Required stiffness of the spring
ix) The actual stiffness of the spring

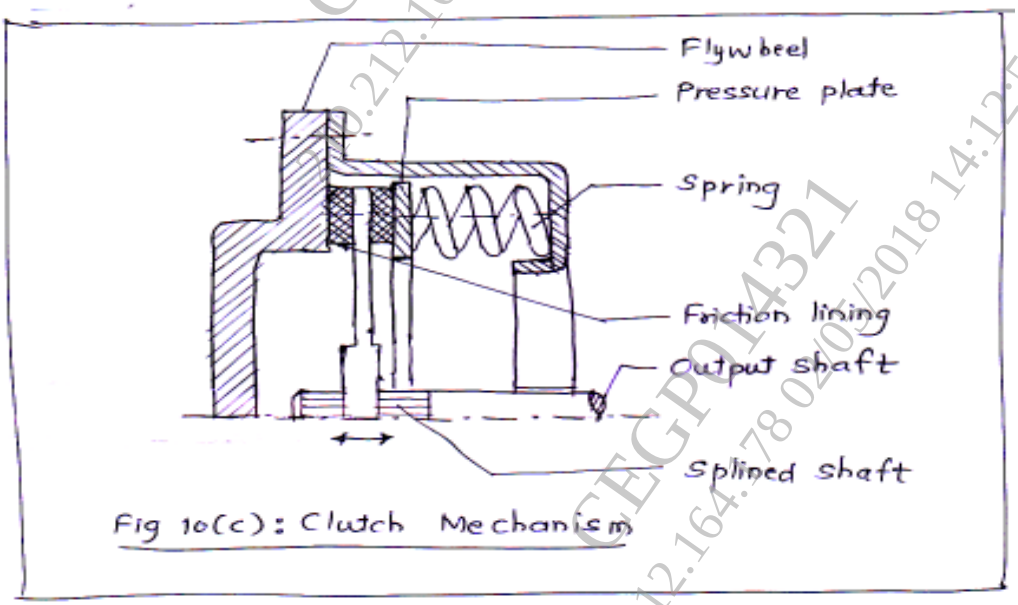

Fig 10(c): Clutch Mechanism