Total No. of Questions :12]

SEAT No. :

P2388

[Total No. of Pages :5

[5153] - 11

T.E. (Mechanical Engineering)

MACHINE DESIGN - I

(2008 Course) (Semester - I)

Time : 4 Hours] *[Max. Marks :100*

Instructions to the candidates:

1) ***Answer 3 questions from Section I and 3 questions from Section II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION-I

Q1) a) What are various failures in Keys? Write corresponding strength expressions. **[4]**

b) The layout of an intermediate shaft of a gear box supporting two spur gears B and C is shown in Figure1. The shaft is mounted on two bearings A and D. The pitch circle diameters of gears B and C are 900 and 600 mm respectively. The material of the shaft is steel FeE 580 (S_{ut} = 770 N/mm^2 and S_{yt} = 580 N/mm^2). The factors k_b and k_t of ASME code are 1.5 and 2.0 respectively. Determine the diameter of shaft using the ASME code. Assume that the gears are connected to the shaft by means of keys. **[12]**

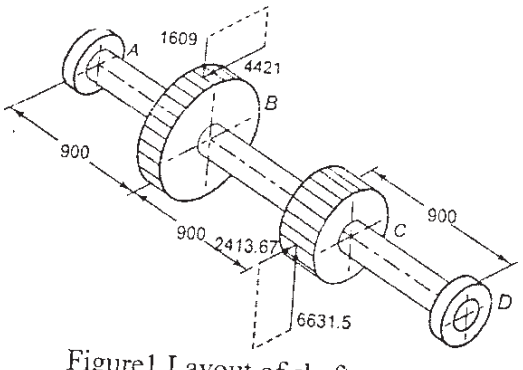

Figure1.Layout of shaft

OR

P.T.O.

Q2) a) When flexible coupling is preferred over rigid coupling? **[4]**

b) A coupling is used to transmit 50kW power at 300 rpm. There are six bolts. The outer diameter of the flanges is 200mm, while the recess diameter is 150mm. the coefficient of friction between the flanges is 0.15. The bolts are made of steel 45C8 (S_{yt} = 380N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes. **[12]**

Q3) a) Derive an expression for maximum efficiency of squre screw. **[6]**

b) A machine vice as shown in Figure 2 has single start, square threads with 22 mm nominal diameter and 5mm pitch. The outer and inner diameters of the friction collar are 55 and 45 mm respectively. The coefficient of friction for thread and collar are 0.15 and 0.17 respectively. The machinist can comfortably exert a force of 125 N on the handle at a mean radius of 150 mm. Assuming uniform wear for the collar, calculate: **[10]**

i) The clamping force developed between the jaws; and

ii) The overall efficiency of the clamp.

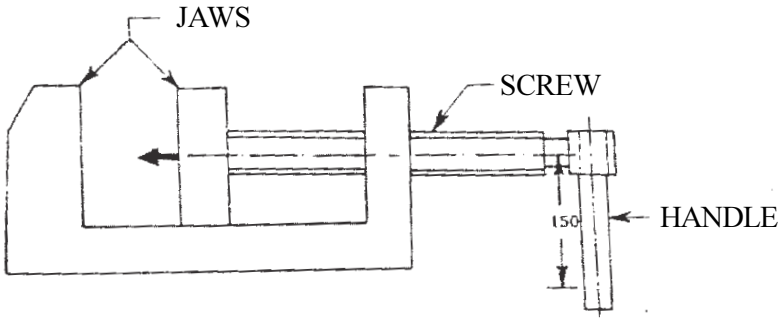

Figure 2 Machine vice

OR

Q4) A C-clamp as shown in Figure 3 has trapezoidal threads of 12 mm outside diameter and 2 mm pitch. The coefficient of friction for screw thread is 0.12 and for collar is 0.25. the mean radius of collar is 6mm. If the force exerted by the operator at end of handle is 80N.

Find;

a) Length of handle,

b) Maximum shear stress in the body of screw and where does this exist

c) Bearing pressure on threads. **[16]**

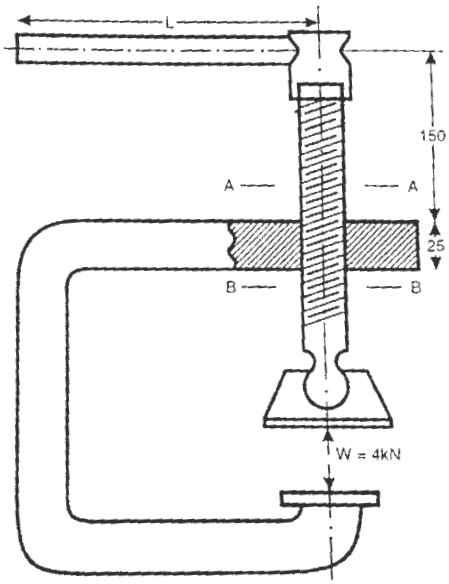

Figure 3. C -clamp

Q5) a) Derive expression for torqued to tighten the bolts. **[8]**

b) A wall bracket is attached to the wall by means of four identifcal bolts, two at A and two at B, as shown in Figure 4. Assuming that the bracket is held against the wall and prevented from tipping about the point C by all four bolts and using an allowable tensile stress in the bolts as 35 N/mm^2, determine the size of bolts on the basis of maximum principal stress theory. **[10]**

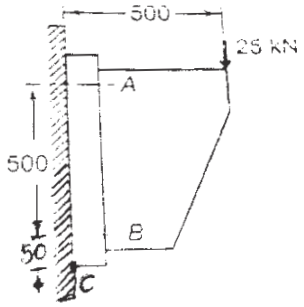

Figure 4. Wall bracket arrangement

OR

Q6) a) Explain design procedure of welded joint subjected to eccentric load in the plane of welds. **[8]**

b) A plate 75 mm wide & 10 mm thick is joined with another steel plate by means of single transverse and double parallel fillet welds as shown in Figure 5. The joint is subjected to a maximum tensile force of 55 kN. The permissible tensile & shear stresses in the weld material are 70 & 50 N/mm^2. Determine the required length of each parallel fillet weld. **[10]**

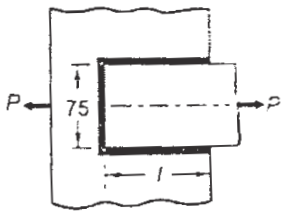

Figure 5. Welded joint

SECTION-II

Q7) a) What are the advantages of a split type flywheel over solid one piece flywheel? **[4]**

b) The torque developed by an engine is given by the following equation:

$T = 14250 + 2200 \sin 2\theta - 1800 \cos 2\theta$

where T is the torque in N-m and θ is the crank angle from inner dead centre position. The resisting torque of machine is constant throughout the work cycle. The coefficient of speed fluctuation is 0.01. The engine speed is 150 rpm A solid circular steel disk, 50 mm thick is used as flywheel. The mass density of steel is 7800 kg/m^3. Calculate the radius of the flywheel disk. **[12]**

OR

Q8) a) Derive expression for stresses in rimmed flywheel. **[4]**

b) The following data is given for a rimmed flywheel made of grey cast iron FG 200:

Mean radius of rim = 1.5 m; thickness of rim = 200 mm; width of rim = 300 mm; Number of spokes = 6; cross sectional area of each spoke = 10,000 mm^2; speed of rotation = 720 rpm;

Calculate

i) tensile stress in rim at $\phi = 30°$ and $\phi = 0°$ and

ii) the axil stress in each spoke. The mass density of cast iron FG 200 is 7100 kg/m^3. **[12]**

Q9) a) Derive an equations for load-deflection and load stress for helical spring. **[6]**

b) It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30 mm. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire The ultimate tensile strength and modulus of rigidity of the spring material are 1090 and 81370 N/mm^2 respectively. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. 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

vi) Pitch of the coil

OR

Q10)a) Derive an equation for stiffness of helical torsion spring. **[6]**

b) Explain nested spring with suitable sketch. **[6]**

c) Write note on multi-leaf spring with sketch. **[6]**

Q11)a) Derive an expression for maximum power transmitting capacity of belt. **[6]**

b) The following data is given for open flat belt drive;

Power transmitting capacity = 15 kW; The centre distance between pulleys is twice the diameter of the bigger pulley. Operating velocity = 20 m/s; Permissible stresses in belt = 2.25 N/mm^2; Lather density = 0.95 g/cc; Coefficient of friction = 0.35. Thickness of belt = 5mm.

Calculate:

i) Diameter of pulley;

ii) Length and width of the belt and;

iii) Belt tensions. **[10]**

OR

Q12)a) Explain with sketch various belt tensioning methods. **[8]**

b) Write selection procedure of V belt from manufacturers catalogue. **[8]**