Total No. of Questions : 12]

SEAT No. :

P1365

[Total No. of Pages : 5

[4858] - 111

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

MACHINE DESIGN - I

(2008 Pattern)

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

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer any three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicates full marks.***
5) ***Use of logarithmic tables & electronic pocket calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Explain the steps for design of Protected type of Flange Coupling. **[4]**

b) A shaft is supported between two bearings 750 mm apart. Power is supplied to the shaft through a coupling located to the left of left hand bearing. Power is transmitted through the shaft by means of a belt pulley, of 450 mm diameter, which is located at a distance of 200 mm to the right of right hand bearing. The pulley is keyed to the shaft and the key effect may be assumed to be extending up to bearing support. The weight of the pulley is 300 N and the ratio of belt tensions of tight and slack side is 2 : 1. The belt tensions act in vertically downward direction. The shaft transmits 12.5 KW power at 300 rpm. The shaft material has yield strength of 300 MPa and ultimate strength of 550 MPa. Assuming combined shock and fatigue factors for bending and torsional moment as 1.5 and 1.0 respectively. Determine – Shaft diameter using ASME code and the various stresses in rectangular key, if key selected has 12 mm width, 10 mm height and 60 mm length. **[14]**

OR

P.T.O.

Q2) a) A steel shaft made of 40C8 is used to drive a machine. The pulley X, Y and bearings A, B is located as shown in fig.1. Determine the diameter of the shaft using ASME code. The yield strength of the shaft material is 330 N/mm^2 and ultimate tensile strength is 600 N/mm^2. Take Kb = 1.5, Kt = 1.2. **[14]**

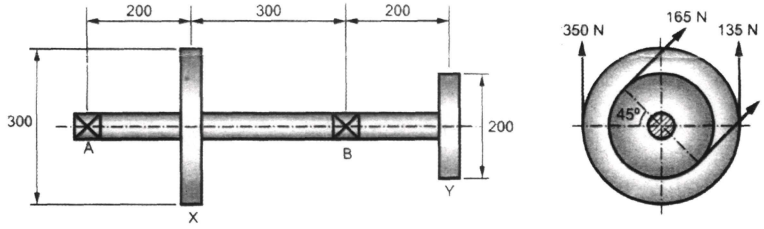

Fig.1

b) Explain the design procedure of Splined shaft. **[4]**

Q3) a) Compare between square thread, Vee threads, Trapezoidal threads and Buttress threads on the following basis: - Manufacturing, Strength, Efficiency, Applications. **[6]**

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 **[10]**

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.

OR

Q4) 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.
v) The number of threads in nut.

Q5) a) What is preloading of bolts? State its advantages. Give two applications of preloading of bolts. **[4]**

b) A rectangular bar of cross - section 200 mm × 150 mm is fillet welded to a plate as shown in fig.2. Determine the size of welded joint if the permissible shear stress of the weld is 79 MPa. **[12]**

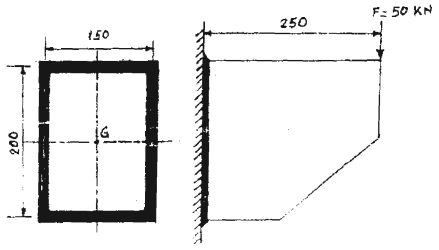

Fig.2

OR

Q6) An offset column is fixed to steel column as shown in fig. 3 by means of four bolts. The bracket is subjected to an inclined pull of 10 KN. Determine the diameter of bolts by assuming allowable tensile stress in bolt to be 150 N/ mm^2. **[16]**

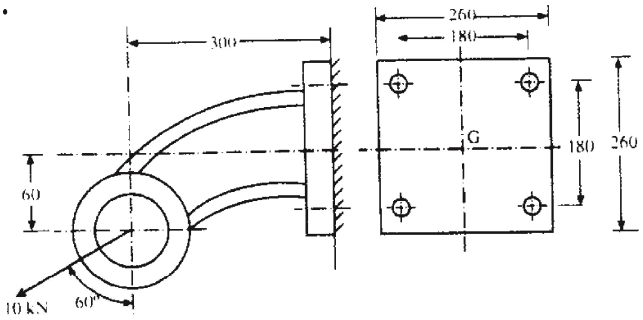

Fig.3

SECTION - II

Q7) A machine is driven by a constant torque electric motor running at a mean speed of 720 rpm. The load torque of the machine is given by 1000 + 400 Sin θ Nm, where θ is the angle of rotation of shaft. A rimmed flywheel made of grey cast iron FG200 (ρ = 7050 Kg/m^3) is used to limit the coefficient of fluctuation of speed to 0.02. The rim contributes 90 % of the flywheel effect. The rim has a rectangular cross-section with width to thickness ratio of 1.5. The number of arms is 6 having elliptical cross-section with major axis twice the minor axis. If the factor of safety is 8. Design the flywheel and find the required power rating of an electric motor. The allowable shear stress for the flywheel shaft is taken as 115 N/mm^2. Assume the limiting linear rim speed at mean radius (V) ≤ 30 m/s. **[18]**

OR

Q8) The T-θ diagram for a four stroke gas engine can be assumed to be consists of four triangles. The areas measured are : 600, 50, 30 and 150 mm^2 for power, exhaust, suction and compression strokes respectively. The scale for the T-θ diagram is 1 mm^2 = 10 J. The engine is running at a mean speed of 500 rpm. The load torque is constant throughout the cycle. A rimmed flywheel made of grey cast iron FG150 (ρ = 7000 Kg/m^3) is used to limit the fluctuation of speed to 3% of the mean speed. The mean diameter of the flywheel rim is limited to 1 m. The rim contributes 90% of the required mass moment of inertia. The rim has a rectangular cross-section with width to thickness ratio of 2. The number of arms is 6 having elliptical cross-section with major axis twice the minor axis. If the factor of safety is 5, design the flywheel and find the power developed by the engine. The allowable shear stress for the flywheel shaft is taken as 40 N/mm^2. **[18]**

Q9) Design a close-coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity is 84 KN/mm^2. End style for the spring is squared and ground. Neglect the effect of stress concentration. **[16]**

OR

Q10) a) Design a helical Compression spring using following data: **[12]**

Maximum load on spring = 4460 N

Mean coil diameter = 85 mm

Spring stiffness = 67 KN/m

Permissible shear stress = 265 N/mm^2

Modulus of rigidity = 81.5 KN/mm^2

Standard wire diameters are ....,14.5,15,15.5,16,16.5,17,...

b) Explain whether following statements are true or false giving reasons : **[4]**

i) Helical torsion spring is subjected to torsional shear stresses.

ii) Helical compression spring is subjected to compressive stress.

Q11) Two parallel shafts are to be connected by an open flat belt. The diameter of pulleys is 400 mm and 800 mm and they are 1 m apart. The initial tension in the belt when it is stationary is 2 KN. The mass of the belt is 2 Kg/m. The coefficient of friction between the belt and the pulley is 0.3. Calculate the power transmitted if the smaller pulley rotates at 1000 rpm. Also suggest the speed of the smaller pulley for maximum power transmission by the belt. Determine this maximum power. **[16]**

OR

Q12) A V-belt drive is used transmit 30 KW power from an electric motor running at 1440 rpm to a machine running at 480 rpm. The central distance between the shafts is 1 m. Groove angle for pulley is 38° and coefficient of friction between the belt and the pulley is 0.2. The density of the belt material is 1000 Kg/m^3 and allowable tensile stress for the belt is 1.53 N/mm^2. The cross-sectional dimensions of the belt are as follows : **[16]**

Width of the belt at the top = 37 mm,

Width of the belt at the bottom = 19 mm and

Depth of the belt 25 mm. Find :

i) Diameter of the pulleys

ii) Minimum numbers of belt required

Assume maximum power transmission capacity condition for belts.

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