Total No. of Questions :12]

SEAT No. :

P2809

[Total No. of Pages :5

[4958] - 111

T.E. (Mechanical Engineering)

MACHINE DESIGN - I

(Semester - I) (2008 Course) (302041)

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

Instructions to the candidates:

1) ***Answer three questions from Section I and three questions from Section II.***
2) ***Answers to the two sections should be written in separate answer - books.***
3) ***Figures to the right indicate full marks.***
4) ***Neat diagrms must be drawn wherever necessary.***
5) ***Use of Electronic Pocket Calculator is allowed.***
6) ***Assume suitable data, if necessary, and mention it clearly.***

SECTION - I

Q1) A belt pulley is keyed to the shaft midway between the supporting bearings kept at 1000 mm apart. The shaft transmits 20 kW power at 400 rpm. The pulley has 400 mm diameter. The angle of wrap of belt on pulley is 180° and the belt tension acts vertically downwards. The ratio of belt tensions is 2.5. The shaft is made of steel having an ultimate tensile strength and a yield strength of 400 N/mm^2 and 240 N/mm^2 respectively. The combined shock and fatigue factors in bending and torsion are 1.5 and 1.25 respectively. The permissible angle of twist in shaft is 0.25° per meter length and the permissible lateral defection is 1 mm per meter length. Design the shaft on the basis of

a) Strength

b) Torsional rigidity

c) Lateral rigidity

Take G = 80×10^3 N/mm^2 and E = 200×10^3 N/mm^2 **[18]**

OR

P.T.O.

Q2) a) State different types of coupling. Explain design procedure for rigid flanged coupling. **[10]**

b) What are different types of keys? Explain design of rectangular sunk key. **[8]**

Q3) A nut from a screw-nut combination, having double start square threads of 25 mm nominal diameter and 5 mm pitch, is acted upon by an axial load of 10 kN, against the direction its linear motion. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction are 0.2 and 0.15 respectively.

The screw only rotates at 12 rpm speed while the nut only translates. Assuming uniform wear condition at collar and allowable bearing pressure of 5.77 N/mm^2, find:

a) Torque required to raise the load

b) Torque required to overcome collar friction

c) Total torque

d) Power required to rotate the screw

e) Stresses in screw body

f) Stresses in screw threads

g) Number of threads of nut in engagement with screw. **[16]**

OR

Q4) a) Prove that maximum efficiency of self-locking square threads is 50%. **[8]**

b) Explain following power screw threads with neat sketch. **[8]**

i) Square threads

ii) Trapezoidal threads

iii) ACME threads

iv) Buttress threads

Q5) a) What are the advantages and disadvantages of welded joints? **[4]**

b) A steel plate subjected to a force of 3 kN and fixed to a vertical channel by using four identical bolts as shown in figure 1. The bolts are made of plain carbon steel (S_{yt} = 380 N/mm^2). If factor safety is 2, find diameter of bolts. **[12]**

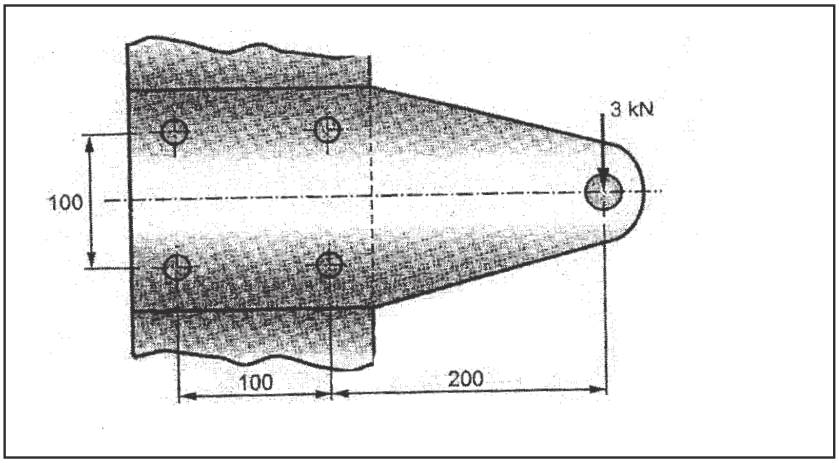

Fig. 1

OR

Q6) a) Explain with neat sketch 4 types of screw fasteners. **[8]**

b) Determine the weld size of an annular fillet used to weld a circular cantilever shaft of a diameter 30 mm and length 100 mm. The force acting at the free end of the shaft is 5 kN and the permissible weld stress is 80 N/mm^2. **[8]**

SECTION - II

Q7) a) Explain different types of stresses induced in

i) Flywheel rim

ii) Flywheel arm **[10]**

b) Explain types of flywheel applications. **[8]**

OR

Q8) a) The torque developed by engine and the load torque of machine are given by

$Te = 5000 + 3000 \sin 2\theta$; and

$Tm = 5000 + 3000 \cos 2\theta$, Where, θ is the crank angle.

The mean speed of flywheel is 240 r.p.m. with coefficient of fluctuation as 0.03. If the mean rim diameter is 800 mm and the density of the flywheel material is 7200 kg/m^3. find

i) Maximum fluctuation of energy; and

ii) The flywheel rim dimensions, neglecting inertia due to arms. Assume flywheel rim width to thickness ratio as 2.0. **[14]**

b) Define: **[4]**

i) Coefficient of fluctuation of speed

ii) Coefficient of fluctuation of energy

Q9) a) Explain following terms used for helical spring. **[8]**

i) Wahl factor

ii) Active and inactive coils

iii) Spring index

iv) Spring rate

b) Draw a neat sketch of a multi-leaf spring and also state use of its essential parts. **[8]**

OR

Q10)a) Design a helical compression spring for a maximum load of 1500 N and a deflection of 30 mm. Assume permissible shear stress for spring material as 420 N/mm^2 and spring index 5.

Take G = 84 GPa. **[10]**

b) Determine required number of coils and the allowable deflection in helical spring made of 1.6 mm diameter wire. Assume the spring index as 6 and a permissible shear stress as 345 N/mm^2. The stiffness of the spring is to be 1.8 N/mm. Take G = 80 GPa. **[6]**

Q11)a) Explain procedure of selection of flat belt from manufacturer's catalogue. **[8]**

b) How wire ropes are designated? Discuss construction and lay of wire ropes. **[8]**

OR

Q12)a) What are different types of belt tensioning methods, explain any one with neat sketch. **[6]**

b) A Pulley of 1000 mm diameter is driven by an open type flat belt from 25 kW, 1440 rpm electric motor. The pulley on the motor shaft is 250 mm in diameter and the center distance between the two shafts is 2.0m. The allowable tensile stress for the belt material is 2 N/mm^2 and the coefficient of friction between the belt and pulley is 0.28.

The density of the belt material is 900 kg/m^3.

If the width of the belt is 125 mm, determine:

i) The thickness of belt

ii) The length of belt and

iii) The initial tension required in the belt. **[10]**