Total No. of Questions : 12]

SEAT No. : ____

P2254

[Total No. of Pages :5

[4758] -11
T.E. (Mechanical Engineering)
MACHINE DESIGN -I
(2008 Course) (Semester -I) (302041)

Time : 4 Hours] ***[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) Draw neat sketch of Kennedy key and clearly mark the area under shear and the area under crushing. Explain the design procedure of Kennedy key. **[4]**

b) A shaft is supported by two bearing placed 1100mm apart. A pulley of diameter 620 mm is keyed at 400mm to the right from left hand bearing and this drives a pulley directly below it with a maximum tension of 2.75KN. Another pulley of diameter 400mm is placed 200mm to the left of right bearing and is driven with a motor placed horizontally to the right. The angle of contact of pulley is 180º and the coefficient of friction between belt and the pulley is 0.3. Find the diameter of the shaft. Assume $K_b = 3$, $K_t = 2.5$, $S_{yt} = 190MPa$, $S_{ut} = 300MPa$. Also find the dimensions of a hollow shaft, having outer diameter of 80mm, for the same data. Compare the weight of the solid shaft to hollow shaft. **[14]**

OR

Q2) a) A counter shaft with the bearings 800mm apart receives 20KW power at 500rpm through a pulley 300mm in diameter and mounted at an overhung of 200mm. A 360 mm diameter pulley mounted midway between the bearings transmits the torque to a shaft located below it. Both the pulleys have vertical belt tensions and the coefficient of friction between the belt and pulley is 0.3. If the required safety margin is 3, design the shaft using

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maximum shear stress theory. Use the following properties for shaft material - S_{ult} = 700 MPa, S_{yt} = 460 MPa. If the above shaft is made hollow with the ratio of inner diameter to outer diameter as 0.6, calculate the ratio of weights of hollow shaft to solid shaft. **[14]**

b) Compare Flexible Coupling with Rigid Coupling & state applications of both. **[4]**

Q3) a) State what type of screw threads will you select for following applications giving reasons and also show the thread form **[6]**

i) Lathe lead screw

ii) Screw Jack

iii) Machine vice

b) A power screw having double start square threads of 25mm nominal diameter and 5mm pitch is acted upon by an axial load of 10KN. The outer and inner diameters of screw collar are 50mm and 20mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.77N/mm^2, find: **[10]**

i) The torque required to rotate the screw

ii) The stresses in screw, and

iii) The height of nut

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? **[6]**

b) In a machine tool application the tool holder is pulled by means of an operating nut, mounted on screw. The tool holder travels at a speed 6m/min. The screw has single start acme threads of 48mm nominal diameter and 8mm pitch. The operating nut exerts a force of 600N to drive the tool holder. the mean radius of the collar is 40mm and the coefficient of friction at thread as well as at the collar surface is 0.2. Calculate, **[10]**

i) Power required to drive the screw

ii) The efficiency of the mechanism.

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

b) A solid rectangular bar of cross-section 80mm (horizontal) by 50mm (vertical) is welded by a 5mm 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 $85N/mm^2$. **[12]**

OR

Q6) A bracket is bolted to column by 6 bolts of equal size as shown in fig.1. It carries a load of 50KN at the distance of 150mm from the centre of column. If the maximum stress in the bolts is to be limited to $150N/mm^2$. Determine the core diameter of bolts. **[16]**

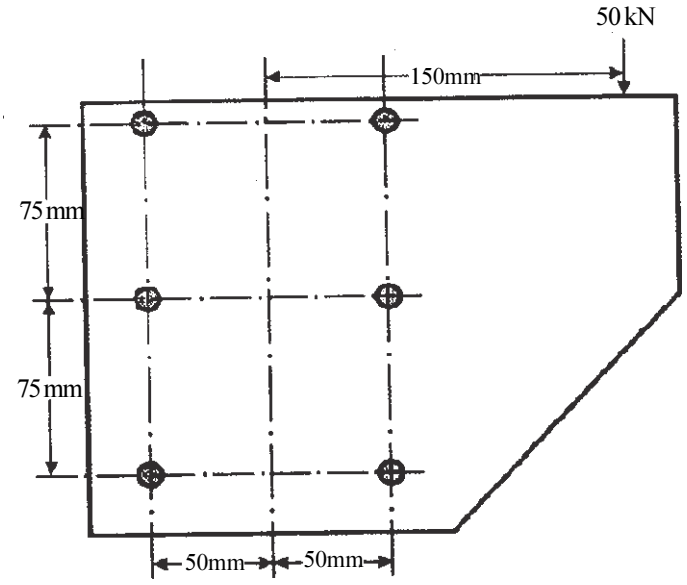

Fig.1

SECTION - II

Q7) A machine with a constant resisting torque is driven by an I.C. engine. The torque developed by the engine is given by expression: $T = 4000 + 1500\sin\theta + 4000 \sin 2\theta$ Nm. A rimmed flywheel made of grey cast iron FG 150 (ρ = $7000kg/m^3$) is used to maintain speed of the engine between 200 rpm and 210 rpm. The rim contributes 90% of the required mass moment of inertia. A maximum diameter of the flywheel is limited to 2.1m. If the factor of safety is 7.5. Design the flywheel. Neglect the effect of restraint of arm on the flywheel rim. **[18]**

OR

Q8) A punching machine with a capacity of punch 30 holes of 20mm diameter per minute in a steel plate of 15mm thickness and having ultimate shear stress of 250N/mm^2 is powered by a flywheel through a gear reducer having a reduction ratio of 10:1. The actual punching operation last for 1/5 of the angular rotation of the punching machine crank shaft. Design a rimmed flywheel made of grey cast iron with a following data: **[18]**

Mechanical efficiency of a punching machine = 85%

Maximum permissible fluctuation of flywheel speed = 10% of mean speed

Maximum permissible diameter of the flywheel = 1.0m

Contribution of the rim to the flywheel effect = 90%

Flywheel rim width to thickness ratio = 2.0

Number of arms = 6

Permissible tensile stress for the flywheel = 7N/mm^2

Mass density of the flywheel material = 7200 kg/m^3

Also find the required power of electric motor to drive the punching machine, if the mechanical efficiency of transmission system is 90%.

Q9) It is required to design a valve spring of IC Engine with following details:**[16]**

Spring load = 80N, When valve is closed

Spring load = 100N, When valve is open

Space constraints for spring fitment are:

Inside guide bush diameter = 24 mm

Outside recess diameter = 36mm.

Valve lift = 5mm

Spring steel has following properties:

Ultimate tensile strength = 710 N/mm^2

Modulus of rigidity = 8.0 $\times 10^4$ N/mm^2

Spring ends are square and ground. Permissible shear stress for spring wire = 0.5 S_{ut}. Determine: Wire diameter, Spring index, Total number of coils, Solid length, Free length, Pitch of the coil when additional 15% of working deflection is used to avoid complete closing of coil.

OR

Q10)a) A torsional helical spring is made from a music wire with wire diameter of 1.37 mm and mean coil diameter 22mm. The spring has 400 turns. If the material of the spring has ultimate tensile strength of 2076MPa and Yield point stress = 0.60 S_{ult} with factor of safety of 2 based on yield point, compute maximum stress on the inside of the helix. Take modulus of elasticity of spring material as 210 GPa. Consider the effect due to stress concentration and due to curvature. Find the torque that spring can exert after unwinding 12 revolutions from the most highly stressed condition. **[12]**

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)A flat belt drive is used to transmit 15KW power from a pulley running at 1440 rpm to another pulley running at 480rpm. The centre distance between pulleys is twice the diameter of larger pulley. The belt velocity is approximately 20.35 m/s. The maximum allowable stress in the belt is 2.25MPa. The density of belt material is 0.95 gm/cc, coefficient of friction is 0.35. The thickness of belt is 5mm. Calculate: **[16]**

a) Diameter of both the pulleys

b) Length and width of the belt

c) Belt tensions.

OR

Q12)A V-belt drive is used for speed reduction between two shafts. Groove angle for the pulley is 40º. Mass of belt is 0.75kg/m. The coefficient of friction is 0.1025. Assuming angle of wrap as 210º, plot a graph of power transmitted by the belt as a function of belt speed. Assume allowable tension in the belt as 900N. Determine optimum belt speed, maximum power transmission. Also find speed of belt at which no power will be transmitted. **[16]**

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