Total No. of Questions :12]

P1596

SEAT No. :

[Total No. of Pages :7

[5058]-11
T.E.(Mechanical Engineering)
MACHINE DESIGN-I
(Semester-I) (302041) (2008 Course)

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 there questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION-I

Q1) A pulley weighing 1.2 KN and 500 mm diameter is driven by a horizontal belt drive. The power is transmitted through a solid shaft to a pinion keyed to the shaft which in turn meshes with a gear. The belt tension and the components of gear reactions on the pinion are as shown in Fig.1. Design the shaft and square key using the values of allowable shear stress for shaft accounting the keyway effect is 41.25 N/mm^{2}and for key the allowable shear stress is 55 N/mm^2. Assume shaft and key are made of the same material. The shock and fatigue factors are: K_b=2.0 and K_t=1.5 Find the torsional deflection of the shaft. **[16]**

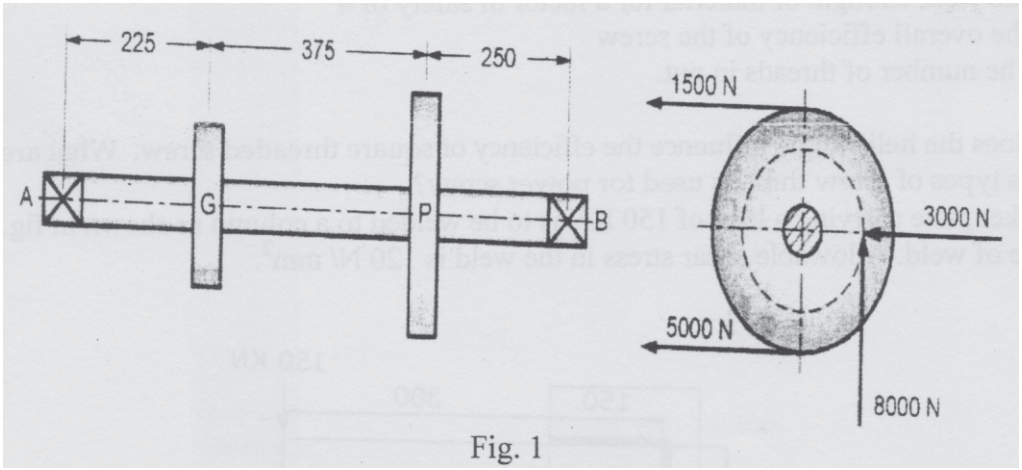

Fig. 1

OR

P.T.O.

Q2) a) A protected type flange coupling is used to transmit 25 KW power at 500 rpm from an engine to a machine. Design the coupling for an overload capacity of 25 % Assume following permissible stresses: **[12]**

	C.I. Flanges	Shaft&Key	Bolts
Permissible tensile stress (N/mm^2)	20	60	60
Allowable shear stress(N/mm^2)	12	35	28
Allowable compressive stress(N/mm^2)	60	60	60
Number of bolts	6		

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

Q3) a) It is required to design a double start screw with square threads for a C - clamp The maximum force exerted by the clamp is 5 KN. It is assumed that the operator will exert a force of 250 N at the ball handle of the hand wheel. The screw is made of plain carbon steel 45C8 ($Syt=330N/mm^2$) while the nut is made of grey cast iron FG200.The factor of safety is 2.5.The distance between axis of handle and nut surface in clamped condition is 275 mm. The mean collar diameter is 12.5mm.The coefficient of friction at screw threads and collar is 0.15 and 0.17 respectively. The permissible bearing pressure is 15 N/mm^2.Design the screw and nut for a C-clamp and determine the following parameters: **[12]**

i) Standard dimensions of screw

ii) Stresses in screw body at two critical sections

iii) Height of nut

iv) Stresses in nut threads

v) Length of handle.

Standard dimensions of square threads(Normal Series)

Nominal Diameter(d)mm	Core Diameter (dc) mm	Pitch(p)mm
22	17	5
24	19	5
26	21	5

b) Show that efficiency of square threads is always less than 50 %. **[4]**

OR

Q4) a) A 26 X 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 MP a 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.

b) How does the helix angle influence the efficiency of square threaded screw. What are the various types of screw threads used for power screw. **[4]**

Q5) A bracket plate carrying a load of 150 KN is to be welded to a column as in fig.2. Find the size of weld. Allowable shear stress in the weld is 120 N/mm^2 **[18]**

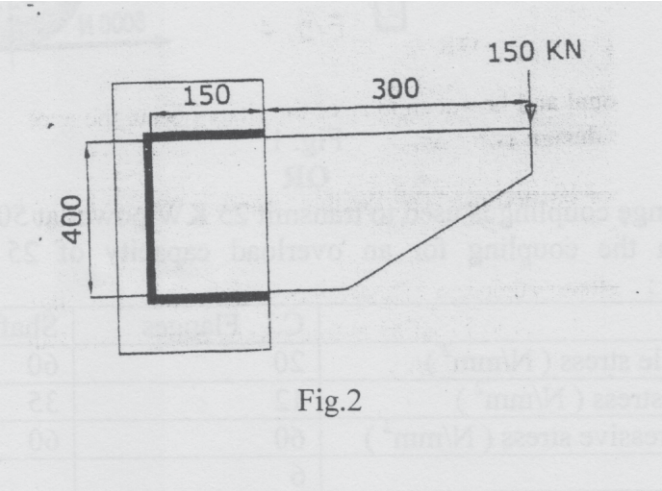

Fig.2

OR

Q6) A bracket is subjected to loading as shown in Fig.3. Determine the size of the bolts if the permissible tensile stress in the bolts is not to exceed 75 MPa. Assume maximum normal stress theory of failure. **[18]**

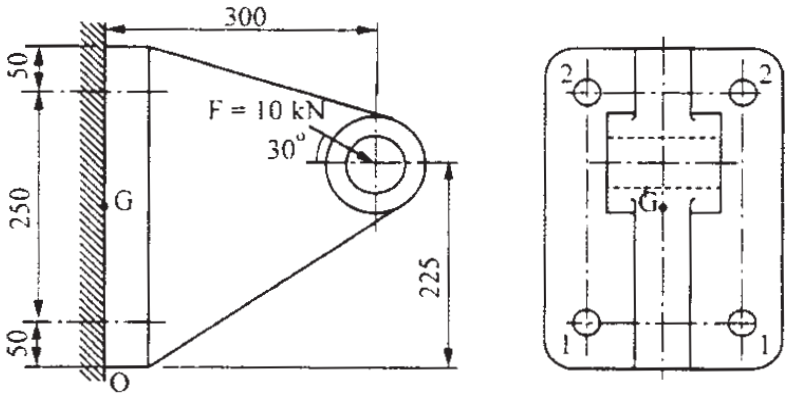

Fig.3

SECTION-II

Q7) A rimmed flywheel is to be used for a four stroke diesel engine which develops 20 KW power at 530 rpm.The load torque is constant throughout the cycle.The hoop stress developed in the flywheel rim is 4.5 N/mm^2. The fluctuation of the speed is limited to $\pm$ 1.5 % of the mean speed. The work done during the power stroke is 40% more than the work done during the whole cycle. The flywheel is made of grey cast iron for which the mass density is 7200 Kg/m^3 and allowable tensile stress is 15 N/mm^2. The rim contributes 90 % of the required mass moment of inertia. The rim has a rectangular cross-section with width to thickness ratio of 2.0. The number of arms is 6 having an elliptical cross-section with major axis twice the minor axis If the allowable shear stress for the key and shaft is 80 N/mm^2, design the flywheel rim, arms, hub and key. **[18]**

OR

Q8) The torque developed by the engine and the load torque of the machine are given by the following expression:

$T_i = 10000 + 5000 \sin 2\theta$ N-m, $T_o = 10000 + 5000 \cos 2\theta$ N-m.

Where θ is the crank angle.

Design a rimmed flywheel made of grey cast iron using the following data:

Maximum speed of the flywheel during the cycle=245 rpm.

Minimum speed of the flywheel during the cycle =235rpm.

Contribution of the rim to the flywheel effect =90%

Flywheel rim width to thickness ratio=2.0

Limiting linear rim speed at mean radius =21 m/s

Numbers of arms=8

Permissible tensile stress for the flywheel =14 N/mm^2

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

Radius of the flywheel hub =80 mm

Also find the power delivered by the engine. **[18]**

Q9) a) Two helical springs are arranged in a concentric manner, with one inside the other. Both the springs have same free length and carry a total load of 5500 N.The outer spring has8 coils with mean coil diameter of 128 mm and wire diameter 16 mm. The inner spring has 12 coils with mean coil diameter of 84 mm and wire diameter 12 mm. Determine: Maximum deflection of each spring and maximum stress in each spring. Assume G=81 GPa. **[12]**

b) Why shot peening is needed for springs. **[4]**

OR

Q10)a) A closed coiled helical compression spring having 12 active coils has a spring stiffnes 'K' This spring is cut into 2 springs having 5 and 7 turns. What will be the stiffness of the resulting springs. **[4]**

b) A loaded narrow gauge rail car weighing 2000 kg mass and moving at 4.32 Km/hr velocity is brought to rest by a bumper consisting of two helical compression springs of spring index6.In bringing the rail car to rest, both the bumper springs get compressed by 140 mm.The spring steel has permissible shear stress of 400 N/mm^2 and the modulus of rigidity is 84000 N/mm^2. Determine the greatest load on each spring, the diameter of spring wire, mean coil diameter, number of coils and the free length of the spring. **[12]**

Q11) The following date is given for an open type V-belt drive

Diameter of driving pulley=120 mm

Diameter of driven pulley=240mm

Centre distance =0.8m

Groove angle=40^o

Mass of belt=0.25 Kg/m

Maximum possible tension=800 N

Coefficient of friction=0.18

Plot a graph of the maximum tension and power transmitted against the belt velocity. **[16]**

OR

Q12) It is required to select a flat belt drive to connect two transmission shafts rotating at 800 rpm and 400 rpm respectively. The centre distance between the two shafts is approximately 3 m and the belt drive is open type. The power transmitted by the belt is 30 KW and the load correction factor is 1.3. The belt should operate at a velocity between 17.8 m/s to 22.9 m/s. The power transmitting capacity of the belt per mm width perply at 180^o arc of contact and a belt velocity of 5.08 m/s is 0.0147 KW. Select the preferred pulley diameters and specify the belt Use the following data:

Standard pulley diameters :

90,100, 112, 125, 140, 160, 180, 200, 224, 250,280, 315, 355, 400,450, 500, 560, 630, 710,800, 900 mm. **[16]**

Arc of contact correction factor(F_d):

Arc of Contact	120^o	130^o	140^o	150^o	160^o	170^o	180^o
	1.33	1.26	1.19	1.13	1.08	1.04	1.00

Number of plies and standard belt widths:

Number of plies	Standard belt widths ‘b’in mm
4	40,44,50,63,76,90,100,125,152
5	76,100,125,152

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