Total No of Questions: [12] *SEAT NO. :* [ ]

[Total No. of Pages : *05*]

UNIVERSITY OF PUNE

T.E. 2008 Course (Mechanical Engineering)

Machine Design-I

(Semester - I)

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 three questions from each section-I and three questions from section-II.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of Electronic Pocket Calculator is allowed.***
6) ***Assume Suitable data, if necessary, and mention it clearly.***

SECTION I

Q1) A counter shaft with the bearing 800 mm apart receives 20 kW power at 500 rpm through a pulley 300 mm in diameter and mounted at an overhang of 200 mm .A 360 mm diameter pulley mounted midway between the bearings transmits the torque to a shaft located below it. Both the pulley 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 maximum shear stress theory. Use the following properties for shaft material. [18]

Ultimate Tensile strength =700 MPa

Yield strength in tension = 460 MPa

If above shaft is made hollow with the ratio of inner diameter to outer diameter as 0.6 calculate the ratio of weight of hollow shaft to solid shaft

OR

Q2) a) Determine the deflection of cantilever beam of length 'L' under force 'F' acting at the free end, by using Castiglione's theorem. Assume uniform flexural rigidity. [06]

b) Design flange coupling for steel shaft transmitting 20 KW power at 250 rpm. Maximum torque is 25%greter than full load torque. Material properties are as follows [12]

i)Allowable shear stress for shaft and key = 40MPa

ii) Allowable shear stress for bolts= 30MPa

Iii)Allowable crushing stress for shaft and key = 80MPa

iv)Allowable shear stress for flange = 14MPa

v)Allowable compressive stress for bolt =60MPa

If the bolts are fitted in the large clearance holes and $\mu = 0.15$.Find dimension of coupling.

Q3) a) Prove that maximum efficiency of self locking square threads is less than 50% [06]

b) The 50 mm mean diameter of square thread screw having pitch of 10 mm. A load of 20 kN is lifted through a distance of 170 mm. find the work done in lifting the load and efficiency of the screw when [10]

i)The load rotates with the screw and

ii) The load rest on loose head which does not rotates with the screw.

The external and internal diameters of bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the bearing surface is 0.08.

OR

Q4) a) Compare V threads ,Square threads and trapezoidal threads for power transmission [08]

b) The following data refers to a 'C' clamp [08]

Maximum force exerted by clamp = 4 kN

Type of Screw =Single start square thread

Nominal diameter = 12 mm

Pitch = 2 mm

Coefficient of screw friction = 0.12

Coefficient of collar frictions = 0.25

Mean Collar radius =6 mm

Force applied by operator at the end of handle = 80 N

Distance between axis of handle and surface of nut in clamp condition =150 mm

Nut height =25 mm. Determine

i. Length of handle

ii. The maximum shear stress in the body of screw and where it exist and

iii. The bearing pressure on thread

Q5) a) State the advantages and limitation of welded joints over riveted joints. [04]

b) A bracket shown in figure 1 is fixed to a steel column by using 4 bolts of size M14. A load W acts on the bracket at a distance of 400 mm from the face of column. The permissible tensile stress for the bolt and bracket material is 84 N/mm^2. The b/t ratio of cross-section of the arm of bracket is 45; [12]

Determine:

i. Maximum load that can be supported by bracket

ii. Cross-section of arm of bracket.

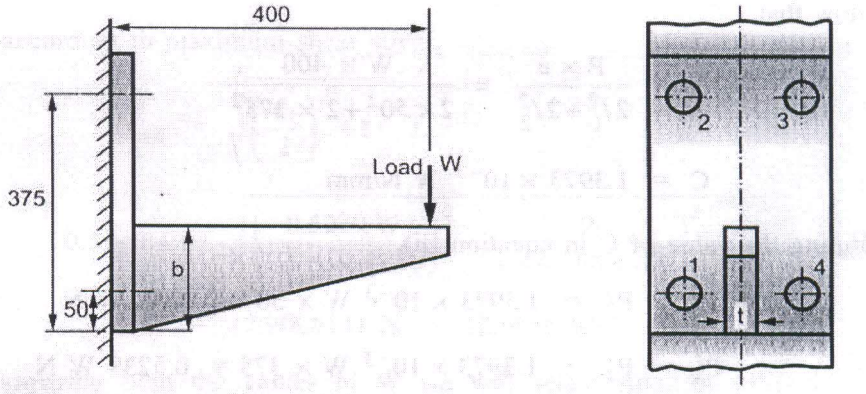

Figure: 1

OR

Q6) a) What is mean by preloading of bolts? State its advantages and applications. [04]

b) A welded bracket as shown in figure 2 carries a load of 30 kN. Calculate size of weld if greatest allowable shear stress in weld is 80 N/mm^2. [12]

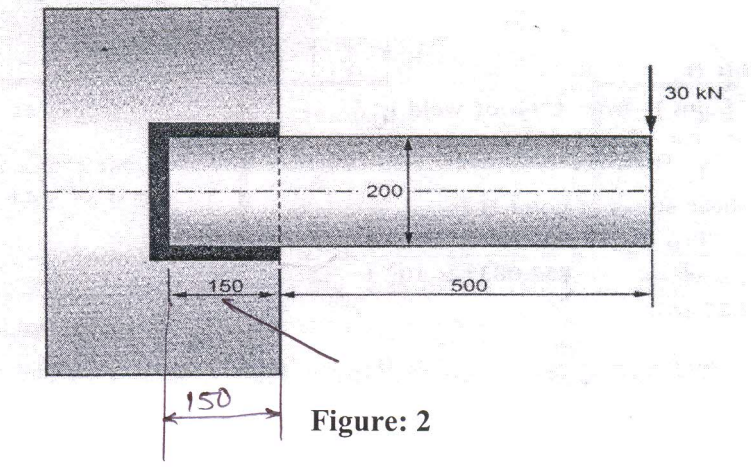

Figure: 2

SECTION II

Q7) a) Write the difference between flywheel and governor. [04]

b) The areas of the turning moment diagram for one revolution of a multi – cylinder engine with reference to the mean turning moment, below and above the line are [12]

$$-32, +408, -267, +333, -310, +226, -374, +260 \text{ and } -244 \text{ mm}^2$$

The scale for abscissa and ordinate are: 1 mm = 2.4° and 1 mm = 650 N-m respectively. The mean speed is 300 rpm with a percentage speed fluctuation of ± 1.5 %. If the hoop stress in the material of the rim is not to exceed 5.6 MPa. Determine the suitable diameter and cross section for the flywheel, assuming that the width is equal to 4 times the thickness. The density of the material may be taken as 7200 kg /m^3. Neglect the effect of the boss and arms.

OR

Q8) a) What are the functions of flywheel? Explain why flywheels are used in presses? [06]

b) The torque developed by engine and the load torque of machine are given by, [10]

$$T_e = 5000 + 3000 \sin 2\theta ;$$

$$T_m = 5000 + 3000 \cos 2\theta.$$

Where θ is the crank angle.

The mean speed of the flywheel is 240 rpm with its coefficient of fluctuation as 0.03. If the mean rim diameter is 800 mm and the mass density of the flywheel is 7200 kg/m^3, find :

i. The 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.

iii.

Q9) a) What is helical torsion spring? How does it differ from helical compression spring? [04]

b) What are the four basic varieties of steel wires used for making helical spring? [04]

c) A concentric spring consists of two helical compression springs having the same free length. The composite spring is subjected to a maximum force of 2000 N. The wire diameter and mean coil diameter of inner spring are 8 and 64 mm respectively. Also, the wire diameter and mean coil diameter of outer spring are 10 and 80 mm respectively. The number of active coils in inner and outer springs is 12 & 8 respectively. Assume [10]

same material for two springs and the modulus of rigidity of spring material is 81370 N/mm^2. Calculate:

i. The force transmitted by each spring.

ii. The maximum deflection of the spring.

iii. The maximum torsional shear stress induced in each spring.

OR

Q10) a) Derive load – deflection equation & strain energy stored in helical spring. [08]

b) 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, G = 84 kN/mm^2. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the end coils. [10]

Q11) a) What is crowing of belt pulleys? [03]

b) What data is required for selecting a V – belt from manufactures catalog? [06]

c) A fan running at 720 rpm is driven by an electric motor running at 1440 rpm through the 8 mm x 250 mm flat leather belt. The center distance is 1370 mm. The coefficient of friction between belt and pulley is 0.35 and belt mass is 957Kg per cubic meter. If the allowable tensile stress for the belt material is 2.0 N/mm2. Determine [07]

i. Max. power transmitting capacity of the belt

ii. Diameters of the pulleys

iii. The required initial tension in the belt.

OR

Q12) a) Explain with a neat sketch design of rope drum? [08]

b) A fiber core wire rope of 6 x 19 class and tensile designation 1230 is to be used in the mine hoist to raise the load of 500 Kg. The maximum acceleration of the load is 1 m/s^2. The modulus of elasticity of the rope is 83000 N/mm^2. If the factor of safety required against static failure is 5, find size of the wire rope and sheave. [08]

Take D= 45d , dw = d/16, & A = 0.404 d^2. & braking strength of the rope is 54000 N.