Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech (AUE)/SEM-4/AUE-405/2010
2010
DESIGN OF MACHINE ELEMENTS

Time Allotted : 3 Hours   Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :   10 × 1 = 10

    i)   Steel containing up to 0·15% carbon is known as

         a)   Mild steel   b)   Dead mild steel

         c)   Medium carbon steel   d)   High carbon steel.

    ii) The algebraic difference between the maximum limit
         and the basic size is called

         a)   Actual deviation

         b)   Upper deviation

         c)   Lower deviation

         d)   Fundamental deviation.

iii) The sleeve or muff coupling is designed as a

    a) Thin cylinder   b) Thick cylinder

    c) Solid shaft   d) Hollow shaft.

iv) Rankine's theory is used for

    a) Brittle materials   b) Ductile materials

    c) Elastic materials   d) Plastic materials.

v) If the tearing efficiency of a riveted joint is 75%, then the ratio of rivet hole diameter to the pitch is equal to

    a) 0·20   b) 0·25

    c) 0·50   d) 0·60.

vi) Match List I (Position of two shafts) with List II (Possible connection) and select the correct answer using the codes given below.

List I	List II
a) Parallel shafts with slight offset	1) Hooke's joint
b) Parallel shafts with reasonable distance	2) Worm and worm wheel
c) Perpendicular shafts	3) Oldham's coupling
d) Intersecting shafts	4) Belt and pulley.

Codes :

	a	b	c	d
A)	4	3	2	1
B)	4	3	1	2
C)	3	4	1	2
D)	3	4	2	1.

vii) The energy stored in a body when strained within elastic limit is known as

a) Resilience

b) Proof resilience

c) Strain energy

d) Impact energy.

viii) In a flat belt drive, if the slip between the driver and belt is 1%, that between follower and belt is 3% and driver and follower pulley diameters are equal, then the velocity ratio of the drive will be

a) 0·99

b) 0·98

c) 0·97

d) 0·96.

ix) A screw is said to be self-locking screw, if its efficiency is

a) less than 50%

b) more than 50%

c) equal to 50%

d) none of these.

x) Two shafts will have equal strength, if

a) diameter of both shafts is same

b) angle of twist of both shafts is same

c) material of both shafts is same

d) twisting moment of both shafts is same.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. The dimensions of the mating parts, according to basic hole system, are given as follows :

	25·00 mm		24·97 mm
Hole :		*Shaft* :	
	25·02 mm		24·95 mm

Find the hole tolerance, shaft tolerance and allowance.

3. Write short notes on the following : $2 \times 2\frac{1}{2}$

    a) Maximum principal (or normal) stress theory (also known as Rankine's theory)

    b) Maximum principal (or normal) strain theory (also known as Saint Venant theory).

4. What is cotter joint ? Explain with the help of a neat sketch, how a cotter joint is made.

5. What are meant by 'Hole basis system' and 'Shaft basis system' ? $2 \times 2\frac{1}{2}$

6. Design the rectangular key for a shaft of 50 mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa.

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. A horizontal shaft *AD* supported in bearings at *A* and *B* and carrying pulleys at *C* and *D* is to transmit 75 kW at 500 r.p.m. from drive pulley *D* to off-take pulley *C*, as shown in Fig. 1. Calculate the diameter of the shaft. The data given is : $P_1 = 2 P_2$ (both horizontal), $Q_1 = 2 Q_2$ (both vertical), radius of pulley *C* = 220 mm, radius of pulley *D* = 160 mm, allowable shear stress = 45 MPa

All dimensions are in mm
Fig. 1
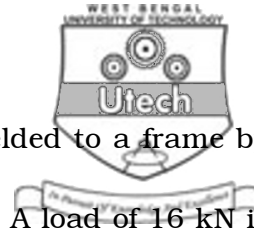
8. A 125 mm × 95 mm × 10 mm angle is welded to a frame by two 10 mm fillet welds, as shown in Fig 2. A load of 16 kN is applied normal to the gravity axis at a distance of 300 mm from the centre of gravity of welds. Find maximum shear stress in the welds, assuming each weld to be 100 mm long and parallel to the axis of the angle.

Fig. 2

9. A double riveted lap joint with chain riveting is to be made for joining two plates 10 mm thick. The allowable stresses are : σ_t = 60 MPa; τ = 50 MPa and σ_c = 80 MPa. Find the rivet diameter, pitch of rivets and distance between rows of rivets. Also find the efficiency of the joint.
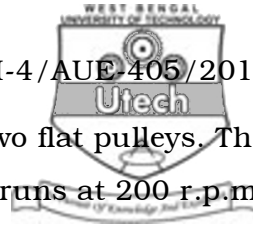
10. A 8 mm thick leather open belt connects two flat pulleys. The smaller pulley is 300 mm in diameter and runs at 200 r.p.m. The angle of lap of this pulley is 160° and the coefficient of friction between the belt and the pulley is 0·25. The belt is on the point of slipping when 3 kW is transmitted. The safe working stress in the belt material is 1·6 N/mm^2. Determine the required width of the belt for 20% overload capacity. The initial tension may be taken equal to the mean of the driving tensions. It is proposed to increase the power transmitting capacity of the drive by adopting one of the following alternatives :

a) By increasing initial tension by 10%, and

b) By increasing the coefficient of friction to 0·3 by applying a dressing to the belt.

Examine the two alternatives and recommend the one which will be more effective. How much power would the drive transmit adopting either of the two alternatives ?

11. Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress = 50 MPa; shear stress = 35 MPa and crushing stress = 90 MPa.

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