Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech (AUE)/SEM-4/AUE-404/2011

2011
THEORY OF MACHINES

*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 : $10 \times 1 = 10$

   i)   Automobile steering gear is an example of

   a)   higher pair

   b)   sliding pair

   c)   turning pair

   d)   lower pair.

   ii)   Peaucellier mechanism has

   a)   eight links   b)   six links

   c)   four links   d)   twelve links.

   iii)   In a rotary engine the angular velocity of the cylinder
   centre line is 25 rad/s and the relative velocity of a
   point on the cylinder centre line with respect to cylinder
   is 10 m/s. Coriolis acceleration will be

   a) 500 m/sec^2 b) 250 m/sec^2

   c) 1000 m/sec^2 d) 2000 m/sec^2.
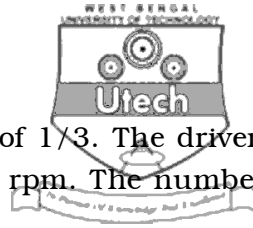
iv) Two spur gears have a velocity ratio of 1/3. The driven gear has 72 teeth and rotates at 300 rpm. The number of teeth and speed of the driver is

    a) 24 rpm & 900 rpm   b) 30 rpm & 1000 rpm

    c) 35 rpm & 1200 rpm   d) 20 rpm & 900 rpm.

v) Total number of instantaneous centres for a mechanism of 4 links is

    a) 8   b) 28

    c) 4   d) 6.

vi) Mitre gears are used for

    a) great speed reduction

    b) transmittiing motion between two intersecting shafts

    c) equal speed

    d) minimum axial thrust.

vii) Typewriter constitutes

    a) machine   b) structure

    c) mechanism   d) inversion.

viii) Pentograph is a mechanism with

    a) 8 links   b) 6 links

    c) 4 links   d) 12 links.

ix) The path of contact in involute gear is

    a) a straight line   b) involute path

    c) curved line   d) circle.

x) A cam in which follower reciprocates or oscillates in a plane parallel to the axis of the cam is known as

    a) cylindrical cam   b) circular cam

    c) reciprocating cam   d) tangent cam.
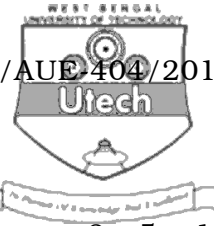
GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2.   Establish Freudenstin's equation for four-bar mechanism.

3.   Explain in brief the working principle of differential gear of an automobile.

4.   What is Coriolis component of acceleration ? Derive an expression for it.

5.   Explain nomenclatures for a cam profiles with a neat sketch.

6.   a)   Establish the relation : $L = 2/3 \, (P + 2)$,

      where L = No. of links, P = No. of pairs with one degree of freedom.

      b)   Write a short note on types of kinematic synthesis. 3 + 2

GROUP – C

(Long Answer Type Questions)

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

7.   a)   Define Degree of Freedom of a linkage. Distinguish between Mechanism, Structure and Preloaded Structure. Determine Degree of Freedom of the linkage in fig. 1 and classify the linkage based on Degree of Freedom.
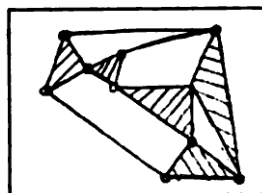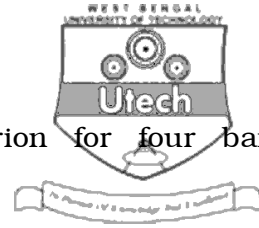

Figure 1

b) State and explain Grashof's criterion for four bar linkages.

c) What do you mean by kinematic inversion ? Illustrate the different inversions of a four bar linkage with suitable examples.

d) Write a short note on Paradox in mechanisms.

(1 + 3 + 2) + 3 + (1 + 3) + 2

8. a) An engine crankshaft drives a reciprocating pump through a mechanism shown in figure 2. The crank rotates in clockwise direction at 160 rpm. The diameter of the pump piston at F is 200 mm. Dimensions of the various links are OA = 170 mm (crank), CD = 170 mm, AB = 660 mm, DE = 830 mm, BC = 510 mm. For the position of the crank shown in the Figure 2, determine

i) the velocity of the crosshead E

ii) the velocity of rubbing at the pins A, B, C and D, the diameter being 40 mm, 30 mm, 30 mm and 50 mm respectively.

iii) The torque required at the shaft O to overcome a pressure of 300 kN/m^2 at the pump piston at F.
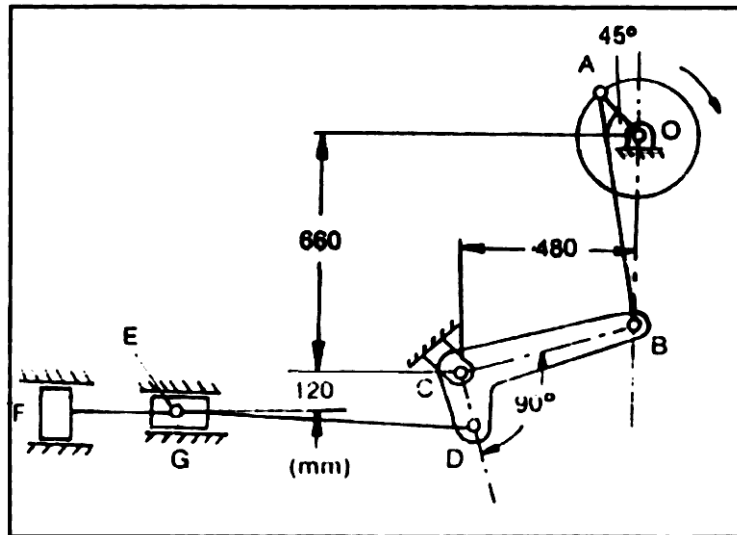

Figure 2

b) State Arnold-Kennedy's theorem for instantaneous centres. 12 + 3

9. a) Determine the Chebyshev spacing for function $y = x^{1.2}$ for range $1 \le x \le 5$ when three precision points are required. For these precision points, determine Φ_j and Ψ_j if $\Phi_0 = 30°$ and $\Psi_0 = 30°$ and $\Delta\Phi = \Delta\Psi = 90°$.

b) Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and the pinion 13 teeth. Does the interference occur ? If it occurs, to what value should the pressure angle be changed to eliminate interference ? 8 + 7

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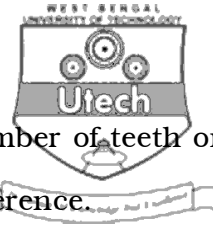
10. a) Deduce an expression for minimum number of teeth on pinion of involutes profile to avoid interference.

 b) Two shafts *A* and *B* are co-axial. A gear *C* (50 teeth) is rigidly mounted on shaft *A*. A compound gear *D-E*, gears with *C* and an internal gear *G*. *D* has 20 teeth and gears with *C* and *E* has 35 teeth and gears with an internal gear *G*. The gear *G* is fixed and is concentric with the shaft axis. The compound gear *D-E* is mounted on a pin which projects for an arm keyed to the shaft *B*. The arrangement is given in Figure 3. Find the number of teeth on internal gear *G* assuming that all gears have the same module. If the shaft *A* rotates at 110 rpm, find the speed of shaft *B*.
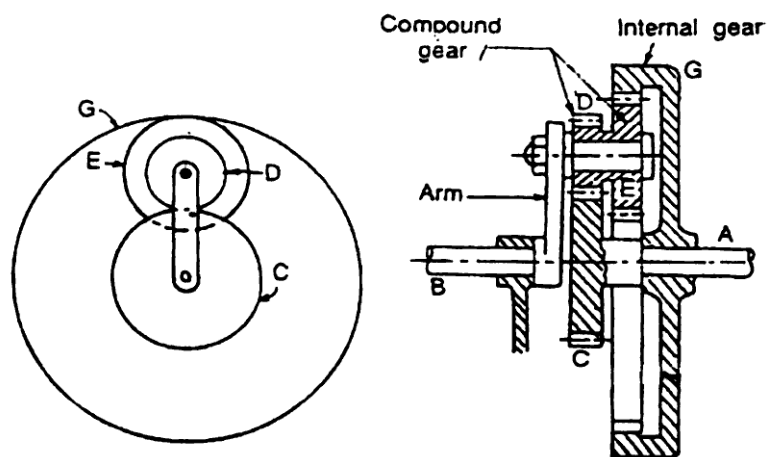

Figure. 3   6 + 9

11. Draw the profile of a cam operating a knife-edge follower from the following data when the axis of the follower is offset by 20 mm right from the axis of the cam shaft :

a) Follower to move towards through 40 mm during 60° of cam rotation

b) Follower to dwell for the next 45°

c) Follower to return to its original position during next 90°

d) Follower to dwell for the rest of the cam rotation.

The displacement of the follower is to take place with simple harmonic motion during both the outward and the return strokes. The least radius of cam is 50 mm. If the cam rotates at 300 rpm, determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke. 15