(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4080 Roll No.

B.Tech.

FOURTH SEMESTER EXAMINATION, 2005-2006

KINEMATICS OF MACHINES

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **ALL** questions.*

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

(iv) Be precise in your answer.

001418

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Distinguish between complete, incomplete and successfully constraint relative motion between two elements or links.

(b) What is the difference between the single slider crank chain and double slider crank chain ? Discuss three important inversions of single slider crank chain and state the purpose for which they are used.

(c) Distinguish between a kinematic chain, a mechanism and a machine. What are the most commonly used kinematic chains consisting of lower pairs ?

(d) Derive an equation for the degree of freedom of a mechanism. Prove that the mechanisms shown in figure 1 is a constrained kinematic chain.

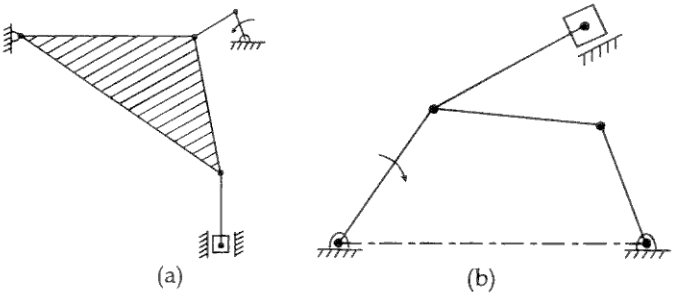

Figure 1

(e) Determine all the centros of the slider crank mechanism shown in figure 2 and find the angular velocity of connecting rod and the velocity of piston. Angular speed of link OA is ω_2 rad/sec. (clockwise).

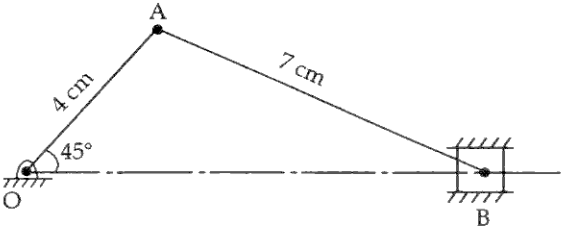

Figure 2

(f) Determine the linear velocity of the slider D shown in the mechanism (figure 3). The slider moves along the horizontal path and OC is vertical.

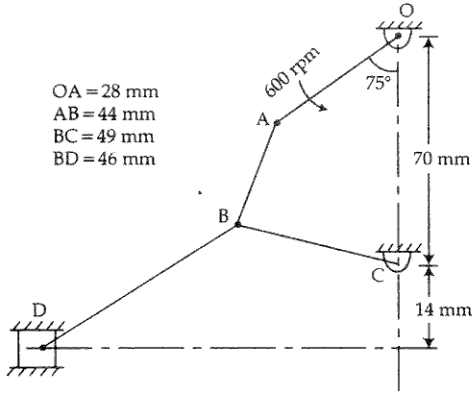

Figure 3

2. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Determine the velocity and acceleration of point B in a 4 bar mechanism shown in figure 4. Assume that link OA rotates with uniform angular velocity of 10 rad/sec counter clockwise as seen by the observer with uniform angular velocity.

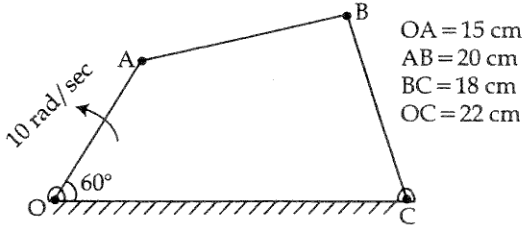

Figure 4

(b) Assume suitable space diagram of crank and slotted lever type quick return motion mechanism and draw the velocity and acceleration diagram. Also indicate various velocity and acceleration components of links in the velocity and acceleration polygons.

(c) Explain Klein's construction for the calculation of acceleration of various links in 4 bar mechanism for any given configuration.

(d) Name different mechanism which gives approximate straight line motions. Describe working of them with neat sketch.

(e) Describe the working of a Hooke's joint with neat sketch. Also prove that,

$\tan\theta = \cos\propto \tan\phi$

Where $\propto$ = angle of inclination of the driven shaft with driving shaft and ϕ and θ are angles turned by driven and driving shafts at any instant.

(f) What do you understand by coriolis acceleration ? Prove that this component of acceleration is equal to $2\vartheta\omega$. How do you decide the direction of this acceleration ?

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) What is kinematic synthesis ? What are the different phases of kinematic synthesis in the solution of a given problem ? How do you find out precision points spacing ?

ıthesize a four-bar mechanism to generate a ɔction $y = \sin x$ for $0 \le x \le 90°$. The range of the ɹtput crank may be chosen as 60° while that of ɲput crank be 120°. Assume three precision points obtained from cheybystev spacing. Assume fixed link to be 50 mm long and $\theta_1 = 105°$ and $\phi_1 = 60°$. Where θ_j and ϕ_j are the angle made by input link and output link at j^{th} position.

Synthesize a slider crank mechanism with an eccentricity of 9 mm for the two input positions of input link $\theta_{12} = 60°$ and output displacement of slider is 16 mm.

Attempt *any two* parts of the following : **(10x2=20)**

(a) Sketch and describe the different types of followers which are used with radial or disc cams. Discuss the advantages and disadvantages of each type.

(b) Draw profile of a cam operating an oscillating roller follower from the following data.

Diameter of roller = 4 cm

Distance of follower fulcrum from cam centre = 10 cm

Length of follower arm from centre of fulcrum = 8 cm to roller centre.

Distance of roller centre from cam centre = 6 cm at the begining of ascent.

Angle moved by cam during ascent of = 60° follower.

Angle moved by cam during which follower remains stationary in the highest position = 45°.

Angle moved by cam during descent = 90° of follower .

Angle of oscillation of follower arm during ascent or descent = 15°.

Ascent and descent both take place with SHM.

(c) Derive the expression for the displacement, velocity and acceleration for a circular arc cam operating a flat-faced follower :

(i) When the contact is on the circular flank and

(ii) When the contact is on the circular nose

5. Attempt *any two* parts of the following : **(10x2=20)**

(a) State and prove the law of gearing and show how the involute teeth profile satisfies the condition. Derive an expression for the velocity of sliding between a pair of involute teeth.

(b) Two mating involute gears of 20° pressure angle have a gear ratio of 2. The number of teeth on pinion is 20 and speed is 250 rpm. Take module as 12 mm.

If the addendum on each wheel is such that the path of approach and path of recess on each side are half of the maximum possible length each. Find :

(i) Addendum for pinion and gear

(ii) Length of arc of contact

(iii) Maximum velocity of sliding during approach and recess.

(c) What are the limitations in design of gear trains ? Discuss different types of gear trains. What are the advantages of epicyclic gear trains over the trains with fixed axes position ?

** *** **