

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

**PAPER ID : 4041**

Roll No.

--	--	--	--	--	--	--	--	--	--

**B.Tech.**

FOURTH SEMESTER EXAMINATION, 2004-2005

**KINEMATICS OF MACHINE**

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.

1. Attempt *any four* of the following : (5×4=20)

- (a) What are different types of constraints ? Explain each with neat sketch.
- (b) Sketch slider crank chain, and its various inversions, stating actual machines in which these are used in practice.
- (c) For a planar mechanism, derive an expression for Grubler's equation and find the degree of freedom for the mechanism shown in figure 1.

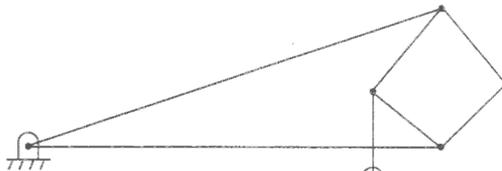
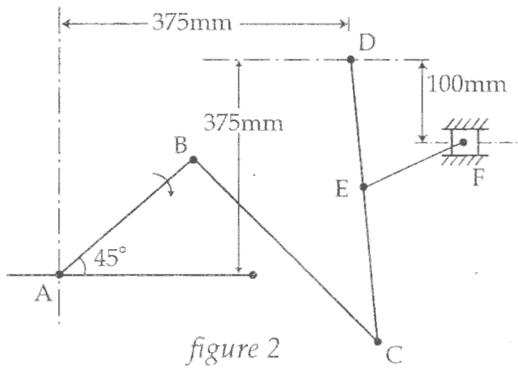


figure 1

- (d) Define instantaneous centre of rotation with the help of neat sketch, show all the instantaneous centres in a slider crank mechanism and find out the expression for the velocity of slider.
- (e) State and prove the Kennedy's theorem of three instantaneous centres.
- (f) The mechanism shown in figure 2 has the dimensions of various links as follows :

$AB = DE = 150 \text{ mm};$   
 $BC = CD = 450 \text{ mm};$   
 $EF = 375 \text{ mm};$

The crank AB rotates in the clockwise direction at a uniform speed of 120 rpm. The lever DC oscillates about D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides, being driven by the link EF. Determine velocity of the block F.



2. Attempt *any four* of the following :

(5x4=20)

- (a) A rigid link is rotating anti clockwise about point A with angular velocity ' $\omega$ ' and angular acceleration ' $\alpha$ '. Describe the method of drawing the acceleration diagram and find the total acceleration of B with respect to A. When link rotates with uniform angular velocity what will be the total acceleration ?
- (b) In a slider crank mechanism, the crank OA is 50 cm long and is rotating at a uniform speed of 300 rpm. The length of connecting rod AB is 2m. Using Klien's construction, determine the acceleration of a point C on the connecting rod (AC=60 cm) when crank makes an angle of  $45^\circ$  with the line of stroke.
- (c) Sketch a quick return motion of the crank and slotted lever type and explain the procedure of drawing the velocity and acceleration diagram, for any given configuration of the mechanism.
- (d) The crank of a slider crank mechanism, as shown in figure 3, rotates at 20 rpm anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm, BC = 450 mm and CD = 450 mm. Determine the linear acceleration of block D.

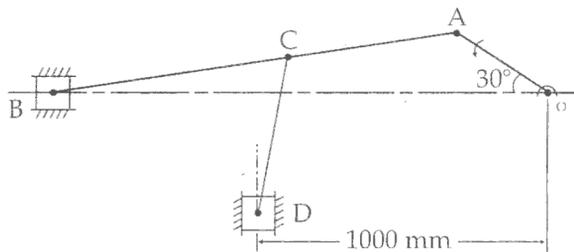


figure 3

- (e) What are straight line mechanisms? Describe one type of exact straight line motion mechanism with the help of neat sketch.
- (f) What is the condition for correct steering? Sketch and show the two main types of steering gears and discuss their relative advantages.
3. Attempt *any two* of the following : (10x2=20)
- (a) Explain Freudenstein's method of three point synthesis of four bar mechanism.
- (b) Synthesize a four bar function generator to solve the equation  $y = 2x^2 - 1$ ,  $1 < x \leq 2$ . Use three precision points and Chebychev spacing. Take a  $\Delta\phi = 60^\circ$ ,  $\Delta\psi = 90^\circ$ ,  $\phi_0 = 30^\circ$  and  $\psi_0 = 60^\circ$ , where  $\Delta\phi$ ,  $\Delta\psi$  are ranges of input and output link rotations and  $\phi_0$ ,  $\psi_0$  are initial angular positions of input and output links respectively.
- (c) Synthesize, graphically, a four bar mechanism for three positions of input and output crank with  $\phi_{12} = 35^\circ$ ,  $\psi_{23} = 30^\circ$ ,  $\psi_{12} = 40^\circ$  and  $\psi_{23} = 60^\circ$  where  $\phi_{ij}$  and  $\psi_{ij}$  are angular distances between position  $i$  and  $j$  of input and output links respectively.
4. Attempt *any two* of the following : (10x2=20)
- (a) What are the different types of followers? Explain with sketches describe different types of motions performed by the follower.
- (b) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with uniform velocity. Also draw the modified displacement, velocity and acceleration diagrams. Why modifications in these diagrams are necessary?

- (c) From the following data draw the profile of a cam in which the follower moves with simple harmonic motion during ascent while it moves with uniform acceleration and retardation motion during descent :

Least radius of cam = 50 mm

Angle of ascent =  $50^\circ$

Angle of dwell between ascent and descent =  $40^\circ$

Angle of descent =  $60^\circ$

Lift of the follower = 40 mm

Diameter of roller = 30 mm

Distance between line of action of the follower and axis of cam = 20 mm

If the cam rotates at 360 rpm, anticlockwise, find the maximum velocity and acceleration of the following during descent.

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

- (a) (i) State and prove the law of gearing.
- (ii) What do you understand by the term 'interference' as applied to gears? How do you eliminate interference?
- (b) A pinion having 20 teeth of 6 module rotates at 200 rpm, transmitting 2 hp to a gear having 50 teeth. The addendum on wheels is 1 module. Find:
- (i) length of path of approach and recess
- (ii) contact ratio

