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Printed Pages : 7 **TME – 402**

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

PAPER ID : 4080 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. IV) EXAMINATION, 2006-07

KINEMATICS OF MACHINES

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*

*(2) All questions carry **equal** marks.*

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

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

(a) What is meant by (i) a resistant body (ii) a lower kinematic pair (iii) a kinematic chain (iv) a mechanism.

(b) Describe with neat sketches a quick-return motion mechanism suitable for a small slotting or shaping machine. Show how the ratio of the times taken on the two strokes is determined.

(c) Prove that if three bodies are in relative motion with respect to one another, the three relative instaneous centres are collinear.

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(d) Find the angular velocity of connecting link CD and that of link AD shown in **Fig.1** when link BC has a constant angular velocity of 2 rad/sec.

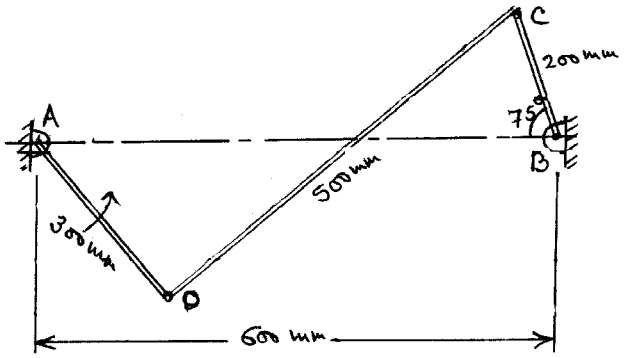

Fig. 1

(e) What do you understand by Degree of freedom ? Determine the degree of freedom of the linkages shown in **fig.2**.

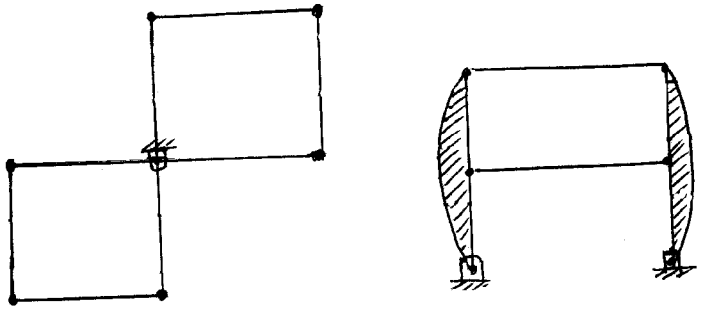

Fig. 2

(f) Discuss various inversions of double slider crank chain with neat sketches.

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2 Attempt any **four** of the following : **5×4=20**

(a) Derive a relationship between the velocity of piston and crank in a crank and connecting rod mechanism, crank having a uniform angular rotation.

(b) Explain Klein's construction for finding acceleration of piston in slider crank mechanism.

(c) The crank of a slider crank mechanism rotates at a constant speed of 250 rpm. The crank is 150 mm and the connecting rod is 500 mm long. Determine the angular velocity and angular acceleration of the connecting rod at a crank angle of 45° from inner dead centre position.

(d) Describe the working of a Davi's steering gear mechanism.

In a Davis steering gear, the distance between the pivots of the front axle is 1.2 metre and the wheel base is 2.5 m. Find the inclination of the track arm to the longitudinal axis of the car, when it is moving along a straight path.

(e) Sketch a pantograph, explain its working and show that it can be used to reproduce to an enlarged scale a given drawing.

(f) What are straight line mechanisms? Describe one type of exact straight line motion and mechanism with the help of a sketch.

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3 Attempt any **two** of the following : **10×2=20**

(a) What is Kinematic Synthesis? Clarify the synthesis problems. How do you find out precision points spacing analytically and graphically?

(b) For the four-bar linkage, the following data are given

$\theta_2 = 60^o$; $\theta_4 = 90^o$

$\omega_2 = 3 rad/sec$; $\omega_4 = 2 rad/sec$

$\alpha_2 = -1 rad/sec^2$; $\alpha_4 = 0$

Determine the length of various links.

(c) Design graphically a 4 bar mechanism such that

$\theta_{12} = 120^o$; $\theta_{13} = 160^o$ and

$\phi_{12} = 70^o$; $\phi_{13} = 110^o$

Input moves anticlockwise and output moves in clockwise direction.

4 Attempt any **two** of the following : **10×2=20**

(a) Discuss the acceleration , velocity and displacement response of followers for the following types of cam :

(i) Parabolic cam

(ii) Simple harmonic cam.

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(b) Derive the expressions for 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.

(c) Draw a cam profile for a knife edge follower with the following data :

(i) Follower to move outward through distance of 2.5 cm during 120^{o} of cam rotation.

(ii) Follower to dwell for 75^{o} of cam rotation

(iii) Follower to return to its initial position during 90^{o} of cam rotation.

(iv) Follower to dwell for the remaining 30^{o} of cam rotation.

The minimum radius of cam is 5 cm and rotating clockwise at a uniform speed. The line of stroke of the follower is offset 15 cm from the axis of cam. Displacement of the followers takes place with SHM dining both the outward and return strokes.

5 Attempt any **two** of the following : **10×2=20**

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

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(b) Two mating involute gears of 20^{o} pressure angle have a gear ratio of 2 and module of 12 mm.The number of teeth on pinion is 20 and speed is 250 rpm. If 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) The addendum for pinion and gear

(ii) The length of arc of contact

(iii) The maximum velocity of sliding during approach and recess.

(c) **Figure 3** shows the gear train arrangement to drive a planning machine. The driving pulley is driven at 360 rpm by an electric motor keyed to the same shaft as this pulley is a 25 tooth pinion driving an 85 tooth gear wheel which is fixed to the same shaft as 35 teeth pinion. This pinion drives a gear wheel that has 130 teeth, fixed to the same shaft as this gear wheel is a 30 teeth pinion which drives a bull wheel. This bull wheel has 75 teeth and meshes with a rack that is bolted to the underside of the table. The pitch of the rack teeth is 25 mm. Calculate the bull wheel speed and the table speed.

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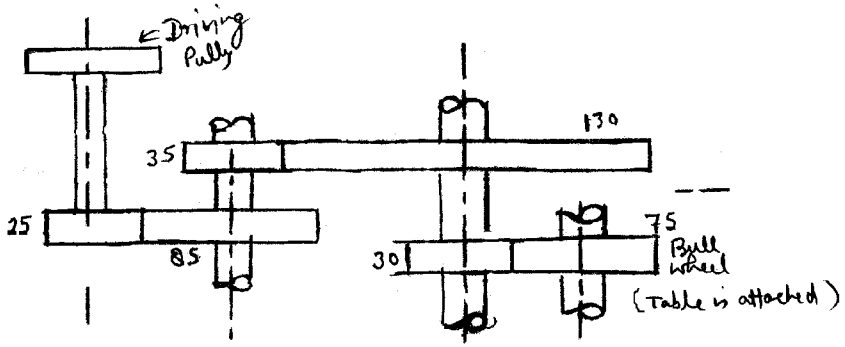

Fig. 3