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No. of Printed Pages—5 **ME–402**

B. TECH.

FOURTH SEMESTER EXAMINATION, 2003-2004

KINEMATICS OF MACHINES

Time : 3 Hours *Total Marks : 100*

Note : Attempt **ALL** questions.

1. Attempt any *FOUR* parts of the following :— **(5×4)**

   (a) Define Kinematic Pair. What are higher and lower pairs ? Draw a neat sketch of slider crank mechanism and give the classification of pairs used in it.

   (b) Define Kinematic link, Kinematic pair and Kinematic chain. Deduce an expression relating the number of links (L) and the number of joints (J) for a kinematic chain.

   (c) What is Inversion of Mechanism ? With the help of neat sketches, explain the inversions of slider crank chain mechanism.

   (d) State and prove the angular velocity ratio theorem for direct contact of links.

   (e) Locate all the instantaneous centres for the mechanism shown in the fig. 1. Determine the ratio of velocities of points D and B and points C and B. Find the angular velocity of Link BC. The crank speed is 500 rpm.

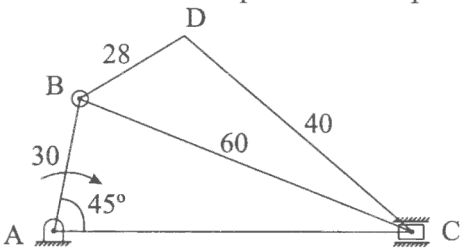

Figure-1

AB rotates at 500 rpm.

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(f) Define Instantaneous Centre of Rotation. Give the types of instantaneous centres. With the help of neat sketch of a four-bar mechanism, show all the types of instantaneous centres.

2. Attempt any *FOUR* of the following :— (5×4)

(a) State the Kendy's Theorem. Using Kendy's theorem, locate all the instantaneous centres of a mechanism.

(b) Derive an expression for the acceleration of piston for a slider crank mechanism.

(c) In the mechanism shown in fig. 2, the block P reciprocates along the fixed line A B and the crank has a uniform speed of 250 rpm. For the given configuration, determine the velocity and acceleration of point P.

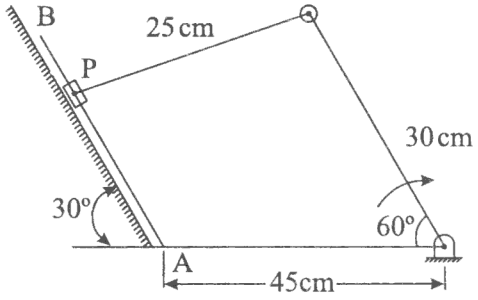
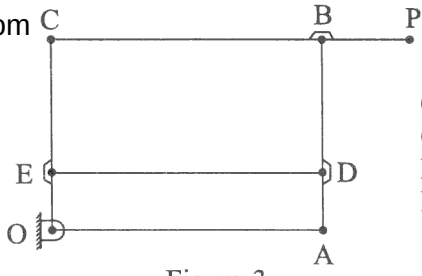


Figure-2

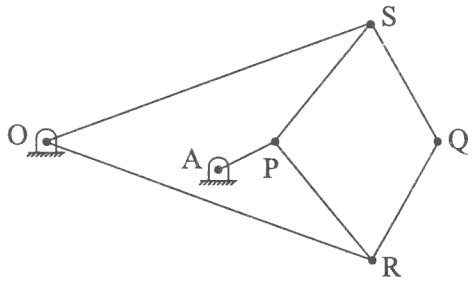
(d) Fig. 3 shows an arrangement of copying mechanism. A circle of diameter 9 cm is to be copied to a reduced scale. Determine the positions of scribing pens and ratio of reduction obtained.



OA=ED=OA=10 cm
OE=AD=2 cm
EC=DB=6 cm
BP=4 cm

Figure-3

(e) Fig. 4 shows Paucelliers mechanism. Describe the path of the tracing point Q.



OA=AP=PS=SQ=QR=RP=15 cm
OR=OS=40 cm

Figure-4

(f) Fig. 5 shows a rotating cylinder engine mechanism. Determine for the given configuration, the angular acceleration of the cylinder about O. The link AP rotates uniformly at 200 rpm in clockwise sense.

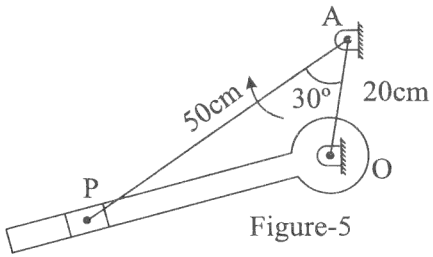


Figure-5

3. Attempt any *TWO* of the following :— (10×2)

(a) What is a Cam ? With the help of neat sketches, describe various types of cams.

(b) Draw a cam profile for a disc cam to give uniform motion during out stroke of 25 mm to a knife edge follower during the first half of the cam rotation. The return of the follower also takes place with uniform motion during the remaining half of the cam rotation. The minimum radius of the cam is 25 mm. The axis of the follower passes through the axis of the cam.

(c) A follower satisfies following requirements :— Stroke of the follower 2·5 cm; OUTSTROKE S.H.M. for 90°; INSTROKE S.H.M. for 80°; Dwell at minimum lift 35°.

Draw the velocity-time and acceleration-time diagram. Determine the maximum velocity and maximum acceleration during the out-stroke.

The cam rotates at 1000 rpm.

4. Attempt any *TWO* of the following :— (10×2)

(a) Derive an expression for minimum number of teeth on a gear wheel.

(b) A pair of gears have 14 and 16 teeth and the module pitch is 12·5 mm. The addendum is also 12·5 mm. The angle of obliquity is $14\frac{1}{2}^{\circ}$.

Show that the gears have interference. Determine the portion by which the addendums of gears must be reduced to avoid interference.

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(c) Fig. 6 shows an epicyclic gear train arrangement. Wheel E is fixed and gears C and D are integrally cast and mounted on one pin. If the Arm 'A' makes one revolution/sec counted clockwise, determine the speed and the direction of rotation of wheels B and F.

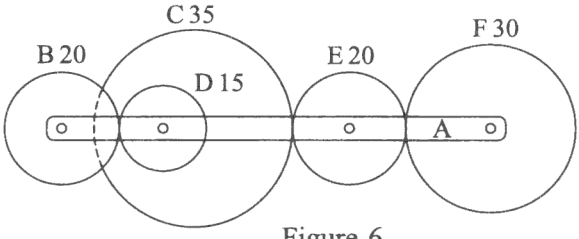

Figure-6

5. Attempt any *TWO* of the following :— **(10×2)**

(a) List the different phases in the solution of problems of kinematic synthesis. Discuss, in detail, the movability of a four-bar linkage and outline the conditions for different kinds of mechanisms.

(b) Determine an expression for minimum number of binary links in a constrained mechanism with simple hinges.

(c) Design a slider crank mechanism so that the displacement of the slider is proportional to the square of the crank rotation in the interval $45° \leq \theta \leq 135°$. Use three point Chebishev spacing.

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