

# CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, June/July 2023

## Kinematics of Machines

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Define the following :  
i) Link    ii) Kinematic pair    iii) Mechanism    iv) Degree of freedom    v) Inversion  
(10 Marks)
- b. Explain with a neat sketch, the crank and slotted lever mechanism. (10 Marks)

OR

- 2 a. What is completely constrained motion and partially constrained motion? Explain with example. (05 Marks)
- b. State Grashoff's law and list inversions of Grashoff's chain. (05 Marks)
- c. With a neat sketch explain, Ackermann steering gear mechanism. (10 Marks)

### Module-2

- 3 a. In a slider crank mechanism, the crank OB is 30mm long and the connecting rod BC is 120mm long. The crank rotates at a uniform speed of 300 rpm clockwise about center 'O'. For a crank position  $\angle BOC$  equal to  $60^\circ$  draw the configuration and find  
(i) Velocity of piston C and angular velocity of connecting rod BC.  
(ii) Acceleration of piston C and angular acceleration of connecting rod BC. (16 Marks)
- b. Define instantaneous center and state the types of instantaneous centers. (04 Marks)

OR

- 4 a. State and prove Kennedy's theorem. (08 Marks)
- b. A four bar mechanism ABCD has AB = 20cm, BC = 30cm, CD = 32 cm and AD = 60cm. Crank AB rotates at a uniform speed of 300 r.p.m in anticlockwise direction. When the crank AB has turned  $60^\circ$ , locate all the instantaneous centers and find the angular velocity of link BC, where AD is fixed. (12 Marks)

### Module-3

- 5 a. What is meant by Loop-Closure equation? Deduce the loop closure equation for the closed loop of a four bar mechanism. (10 Marks)
- b. The crank of an engine is 50 cm long and the connecting rod length to crank radius is 4. Determine the velocity of the piston, when the crank has turned through  $40^\circ$  from top dead center position. The crank is rotating at 100 rad/sec in clockwise direction. By complex algebra analysis method, find out the velocity of the piston. (10 Marks)

OR

- 6 a. Explain the following with a diagram wherever required:  
i) Function generation  
ii) Precision points  
iii) Structural error  
iv) Mechanical error (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg.  $42+8=50$ , will be treated as malpractice.

- b. A schematic of a four bar mechanism with input link 'a' and output link 'c' is shown in Fig.Q6(b). The angles  $\theta$  and  $\phi$  for three successive positions are given in the table below:

Angles	1	2	3
$\theta$	55	25	-25
$\phi$	110	40	-50

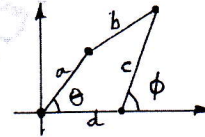


Fig.Q6(b)

If the length of the grounded link 'd' is 40mm, using Freudenstein's equation, find out length of other links to satisfy the given positional conditions. (12 Marks)

#### Module-4

- 7 A cam with 30mm as minimum radius is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follower as follows:
- Follower to move outward through 30mm during  $120^\circ$  of CAM rotation with SHM.
  - Dwell for the next  $60^\circ$ .
  - Follower to return to its starting position during the next  $90^\circ$  with SHM.
  - Dwell for the remaining period.
- Draw the CAM profile when the follower axis passes through CAM axis. Also find the maximum velocity and acceleration during the outward and return stroke. (20 Marks)

OR

- 8 A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below:
- Outward during  $150^\circ$  with UARM
  - Dwell for next  $30^\circ$
  - Return during next  $120^\circ$  with SHM.
  - Dwell for the remaining period.
- Stroke of the follower is 3cm. Minimum radius of cam is 3cm. Draw the cam profile when the follower axis passes through cam axis. (20 Marks)

#### Module-5

- 9 a. State and prove the law of gearing for constant velocity ratio. (10 Marks)
- b. Two involute gears with number of teeth 28 and 45 are in mesh. If they have standard addendum of 3 mm and pressure angle is  $20^\circ$ , find the following ;
- Path of approach
  - Path of recess
  - Contact ratio
- Assume module is 3mm. (10 Marks)

OR

- 10 The arm C of an epicyclic gear train rotates at 100 rpm in anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the center of wheel A. Find the speed of wheel B. What will be the speed of B, if wheel A instead of being fixed makes 200 rpm clockwise? (20 Marks)

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