

6. Define forward and inverse kinematics. Calculate the Jacobian of two links planar arm when  $\theta_1 = 45^\circ$  and  $\theta_2 = 20^\circ$ . **15**

#### Section IV

7. For a rigid body subjected to a point force  ${}^0\bar{F}_p$  at point P, prove that : **15**

$${}^0_C \tau = \frac{d}{dt} \left\{ \left[ {}^0_C I_B \right] {}^0_0 \bar{\omega}_B \right\}$$

8. Explain any *three* of the following : **15**
- Degree of freedom of a robot
  - State space form
  - Newton-Euler dynamic formulation
  - Lagrangian formulation of manipulator dynamics

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**CC-83**

**M. Tech. EXAMINATION, May 2017**

(Third Semester)

(Re-appear Only)

(ME)

MED-601-B

MECHANISM AND MANIPULATOR DESIGN

*Time : 3 Hours]*

*[Maximum Marks : 75*

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Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

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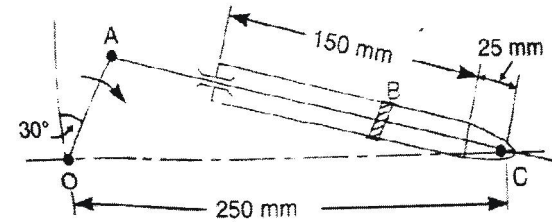
**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Section. All questions carry equal marks.

### Section I

1. Sketch and describe the working of two different types of quick return mechanism. Give example of their application. Derive an expression for the ratio of times taken in forward and return stroke for one of these mechanism. **15**

2. In the oscillating cylinder mechanism as shown in Fig., crank OA is 50 mm long while the piston rod AB is 150 mm long. The crank OA rotates uniformly about O at 300 r.p.m. Determine for the position shown : **15**

- (a) Velocity of the piston B relative to the cylinder walls
- (b) Angular velocity of piston rod AB
- (c) Sliding acceleration of piston B relative to the cylinder wall.
- (d) Angular acceleration of piston rod AB.



### Section II

3. Describe the classification of synthesis problem. **15**
4. Design a four bar mechanism to coordinate input and output angles as follows : **15**  
Input angles =  $15^\circ$ ,  $30^\circ$  and  $45^\circ$   
Output angles =  $30^\circ$ ,  $40^\circ$  and  $55^\circ$

### Section III

5. States different types of hydraulic actuators. What are the risks using hydraulic actuators ? **15**