

**B. TECH**  
**(SEM V) THEORY EXAMINATION 2019-20**  
**KINEMATICS OF MACHINES**

**Time: 3 Hours**

**Total Marks: 100**

**Note:** Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

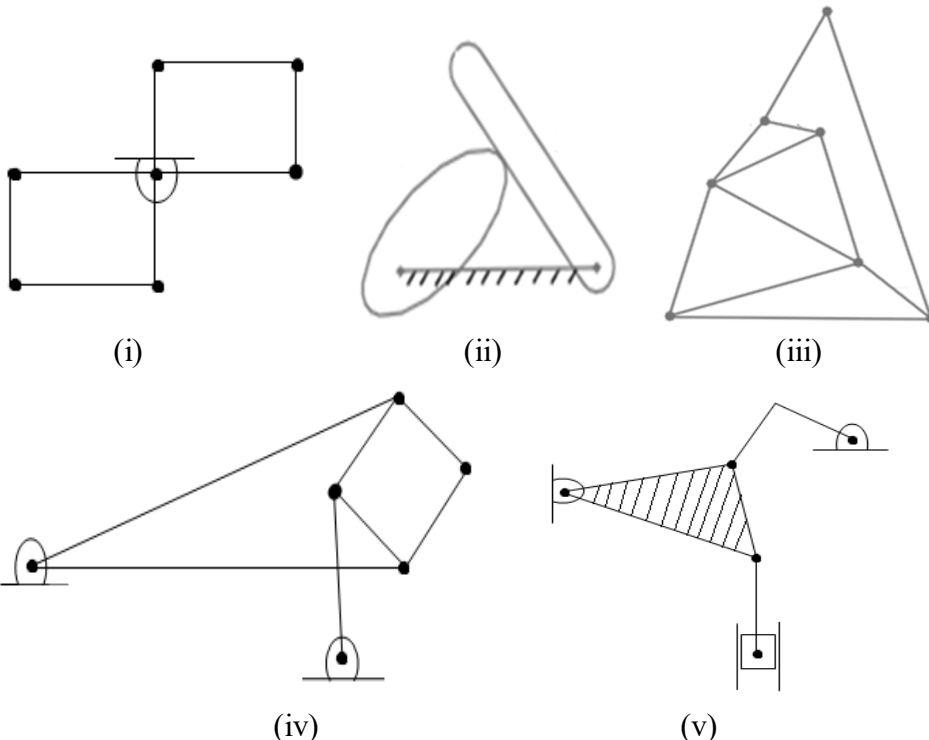
**1. Attempt all questions in brief. 2 x 10 = 20**

- a. How do you classify the kinematic pairs?
- b. State the *Aronhold-Kennedy's* theorem as applicable to instantaneous centres of rotation of three bodies.
- c. What do you mean by kinematic synthesis of mechanism?
- d. What is the function of Hooke's joint?
- e. Explain any four terminology of cam profile.
- f. Differentiate between Radial follower and Off-set follower.
- g. Define fundamental law of gearing.
- h. Differentiate between involute and cycloidal profile of gear tooth.
- i. What do you mean by creep of belt?
- j. What is the function of clutch?

**SECTION B**

**2. Attempt any three of the following: 10 x 3 = 30**

- a. Find the degrees of freedom of the following Mechanisms:



- b. Two shafts are connected by a Hooke's joint. The driving shaft revolves uniformly at 500 r.p.m. If the total permissible variation in speed of the driven shaft is not to exceed  $\pm 6\%$  of the mean speed, find the greatest permissible angle between the centre lines of the shafts.

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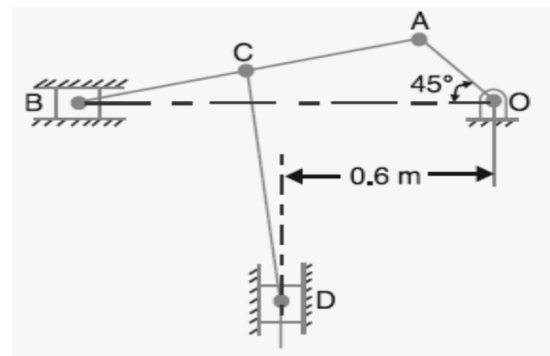
- c. Deduce the expression for displacement, velocity and acceleration when the follower moves with simple harmonic motion and also draw the velocity and acceleration profile.
- d. Define interference in gears. Derive an expression for minimum number of teeth required on a wheel in order to avoid interference.
- e. A conical pivot supports a load of 20 kN, the cone angle is  $120^\circ$  and the intensity of normal pressure is not to exceed  $0.3 \text{ N/mm}^2$ . The external diameter is twice the internal diameter. Find the outer and inner radii of the bearing surface. If the shaft rotates at 200 r.p.m. and the coefficient of friction is 0.1, find the power absorbed in friction. Assume uniform pressure.

## SECTION C

3. Attempt any *one* part of the following:

10 x 1 = 10

- (a) The lengths of various links of a mechanism, as shown in figure, are,  $OA = 0.3 \text{ m}$ ,  $AB = 1 \text{ m}$ ,  $CD = 0.8 \text{ m}$ , and  $AC = CB$ . Determine, for the given configuration, the velocity of the slider D if the crank OA rotates at 60 r.p.m. in the clockwise direction. Also find the angular velocity of the link CD. Use instantaneous centre method.



- (b) Draw the Kinematic link diagram of Crank & Slotted lever QRMM, and hence, also deduct an expression for its stroke length.

4. Attempt any *one* part of the following:

10 x 1 = 10

- (a) What do you understand by Coriolis component of acceleration? Show that magnitude of Coriolis component of acceleration is  $2v\omega$ , where  $v$  is velocity of slider and  $\omega$  is angular velocity of link in which slider is sliding. How is the sense and direction of this acceleration determined?
- (b) A petrol engine has a stroke of 120 mm and connecting rod is 3 times the crank length. The crank rotates at 1500 r.p.m. in clockwise direction. Determine: 1. Velocity and acceleration of the piston, and 2. Angular velocity and angular acceleration of the connecting rod, when the piston had travelled one-fourth of its stroke from I.D.C.

5. Attempt any *one* part of the following:

10 x 1 = 10

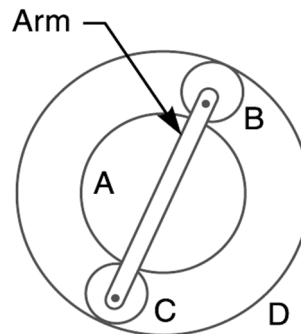
- (a) Analyze the movement of a Reciprocating roller follower on a tangent cam. Find expression for the Displacement, velocity and acceleration of the follower, when the follower is on the flank portion.
- (b) A cam with a minimum radius of 25 mm is to be designed for a roller follower of diameter 16 mm with the following data:
  - To raise the follower through 35 mm during  $60^\circ$  rotation of the cam with uniform velocity
  - Dwell for next  $40^\circ$  of cam rotation
  - Descending of the follower during next  $90^\circ$  of the cam rotation with uniform acceleration and deceleration.
  - Dwell during the rest of the cam rotation

Draw the profile of the cam if Radial follower (Line of stroke of follower passes through the axis of the cam shaft).

6. Attempt any *one* part of the following:

10 x 1 = 10

- (a) Define the following with respect to Gear: Pressure angle, Pitch point, Circular Pitch, Backlash and Contact Ratio
- (b) An epicyclic train of gears is arranged as shown in figure. How many revolutions does the arm, to which the pinions B and C are attached, make: **1.** when A makes one revolution clockwise and D makes half a revolution anticlockwise, and **2.** when A makes one revolution clockwise and D is stationary? The number of teeth on the gears A and D are 40 and 90 respectively.

7. Attempt any *one* part of the following:

10 x 1 = 10

- (a) Derive the condition for maximum power transmission by a belt drive considering the effect of centrifugal tension.
- (b) An open belt drive connects two pulleys 1.2 m and 0.5 m diameter, on parallel shafts 4 meter apart. The mass of the belt is 0.9 kg per meter length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 0.3. The 1.2 m pulley, which is the driver, runs at 200 r.p.m. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 r.p.m. Calculate the torque on each of the two shafts, the power transmitted, and power lost in friction. What is the efficiency of the drive?