

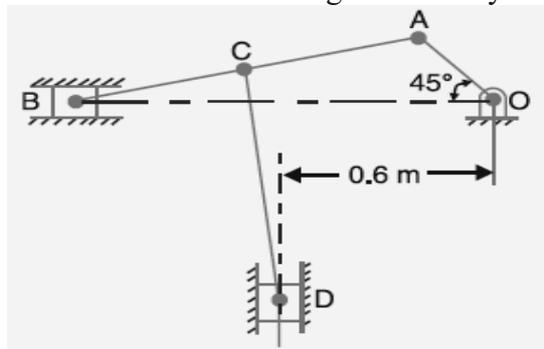
**B TECH**  
**(SEM-V) THEORY EXAMINATION 2018-19**  
**KINEMATICS OF MACHINES**

**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**
- Which follower motion program do you recommend for a high-speed cam and why?
  - Two gears having an angular velocity ratio of 3: 1 are mounted on shafts whose centers are 136 mm apart. If the module of the gears is 4 mm, how many teeth are there on each gear?
  - Explain condition which must be fulfilled by the steering gear mechanism for correct steering.
  - What is degree of freedom of a mechanism? Explain its importance in brief
  - What do you mean by Coriolis component of acceleration? Also explain how we can determine the direction of Coriolis component of acceleration?
  - What do you mean by self-locking brakes and self-energizing brake?
  - Explain Pressure angle and its importance in cam follower pair.
  - Describe the necessary condition for straight-line motion generation mechanism.
  - Draw polar velocity diagram of a Hooke's joint and marks its salient features.
  - What do you mean by instantaneous Centre? Explain properties of it.

**SECTION B**

2. **Attempt any three of the following:** **10 x 3 = 30**
- The two shafts of a Hooke's coupling have their axes inclined at  $20^\circ$ . The shaft *A* revolves at a uniform speed of 1000 rpm. The shaft *B* carries a flywheel of mass 30 kg. If the radius of gyration of the flywheel is 100 mm, find the maximum torque in shaft *B*.
  - The lengths of various links of a mechanism, as shown in Figure are,  $OA = 0.3$  m,  $AB = 1$  m,  $CD = 0.8$  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*.

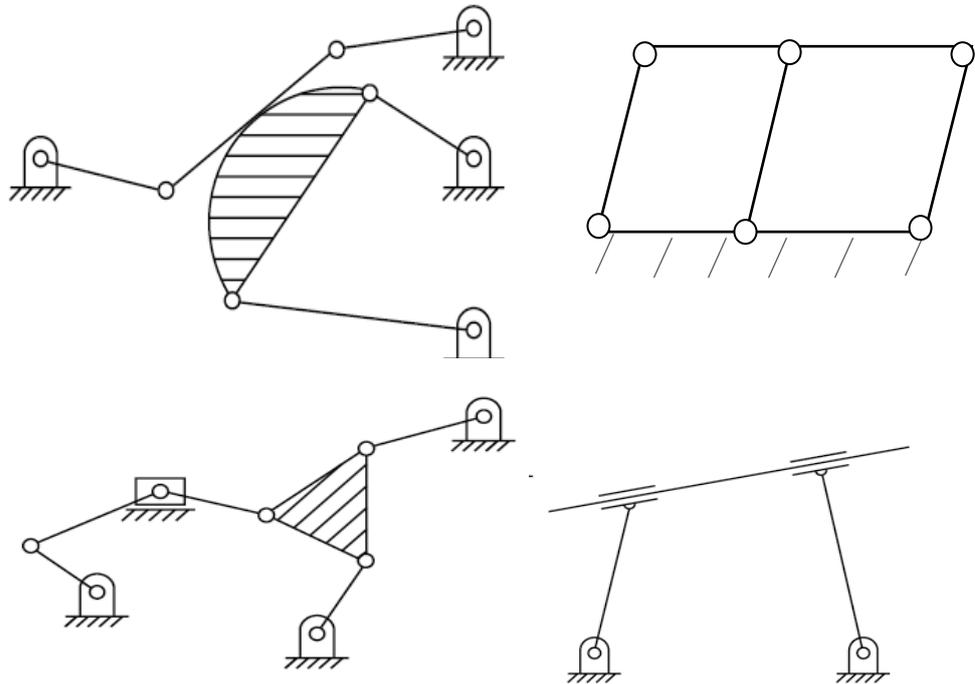


- The following data relate to a symmetrical circular cam operating a flat-faced follower:
  - Minimum radius of the cam = 40 mm
  - Lift = 24 mm
  - Angle of lift =  $75^\circ$
  - Nose radius = 8 mm
  - Speed of the cam = 420 rpm

Determine the main dimensions of the cam and the acceleration of the follower at:

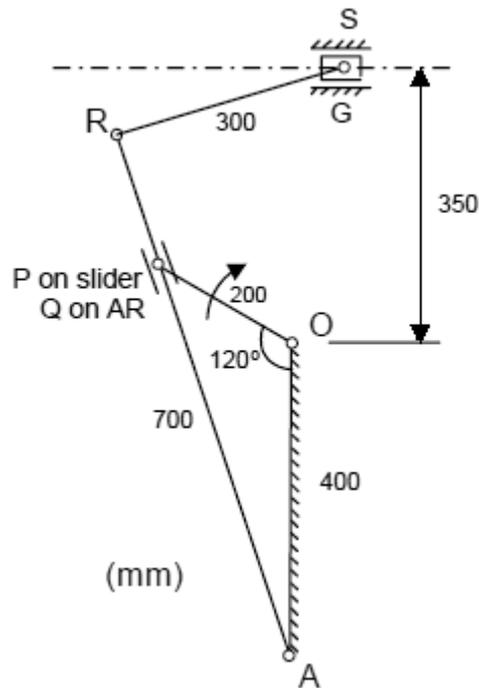
- (i) the beginning of the lift
- (ii) the end of contact with the circular flank
- (iii) the beginning of contact with the nose
- (iv) the apex of nose.

- d. A leather belt transmits 10 kW from a motor running at 600 rpm by an open-belt drive. The diameter of the driving pulley of the motor is 350 mm, center distance between the pulleys 4 m and speed of the driven pulley 180 rpm. The belt weighs 1100 kg/m<sup>3</sup> and the maximum allowable tension in the belt is 2.5 N/mm<sup>2</sup>.  $\mu = 0.25$ . Find the width of the belt assuming the thickness to be 10 mm. Neglect the belt thickness to calculate the velocities.
- e. Determine the degree of freedom of following cases:



### SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10
- (a) Define the term kinematic pair. Also give complete classification of kinematic pairs with suitable example
  - (b) What do you mean by kinematic inversion of mechanism? Explain inversions of double slider chain with diagrams.
  - (c) In a slider crank mechanism, the lengths of the crank and the connecting rod are 200 mm and 800 mm respectively. Locate all I-centers of the mechanism for the position of the crank when it has turned 300° from the outer dead center. Also find the velocity of slider and the angular velocity of the connecting rod, if the crank rotates at 40 rad/sec.
4. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Figure given below shows the link mechanism of a quick-return mechanism of the slotted lever type, the various dimensions of which are  
 $OA = 400$  mm,  $OP = 200$  mm,  $AR = 700$  mm,  $RS = 300$  mm.  
 For the configuration shown determine the acceleration of the cutting tool at  $S$  and the angular acceleration of the link  $RS$ . The crank  $OP$  rotates at 210 rpm.



- (b) Attempt both parts: 3 + 7 = 10
- i. In a Davis steering gear mechanism, find the inclination of the track arm to the longitudinal axis of the car, when the car is moving on a straight path. Given the distance between the pivots of the front axle is 1.0675 m and wheel base is 2.5925 m.
  - ii. What are straight line motion mechanisms? Name the different types of mechanisms used for straight line motion. Explain working of any one with the help of suitable diagram.

**5. Attempt any *one* part of the following:** **10 x 1 = 10**

- (a) A cam with 30 mm minimum radius is rotating clockwise at 1200 rpm to give the following motion to a knife edged follower:
  - Lift = 30 mm
  - Follower rises during  $120^\circ$  cam rotation with simple harmonic motion
  - Follower to dwell for  $60^\circ$  cam rotation
  - Follower to return during  $90^\circ$  rotation with constant acceleration and deacceleration motion
  - Follower to dwell for remaining period
 Draw cam profile and find the maximum velocity and acceleration of follower during ascent and descent.
- (b) Derive relations to find velocity and acceleration of a roller follower moving on the radial cam, when roller is in contact with flank and nose.

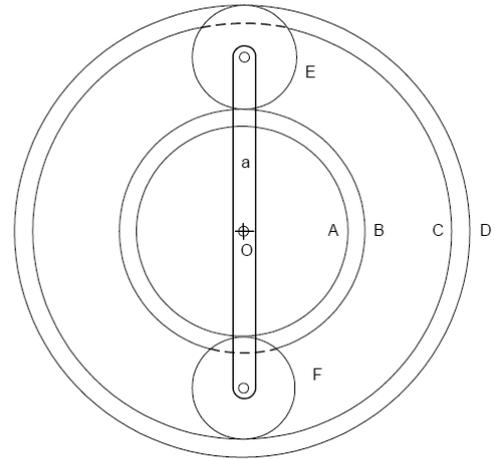
**6. Attempt any *two* parts of the following:** **5 x 2 = 10**

- (a) State and prove the law of gearing. Derive an expression for the velocity of sliding between a pair of involute teeth.
- (b) In the epicyclic gear train shown in Figure the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pins fixed to arm a. All the wheels are of the same module. The number of teeth on the wheels are

$$T_A = 52, T_B = 56, T_E = T_F = 36$$

Determine the speed of *C* if

- (i) the wheel *D* fixed and arm *a* rotates at 200 rpm clockwise
- (ii) the wheel *D* rotates at 200 rpm counter-clockwise and the arm *a* rotates at 20 rpm counter-clockwise



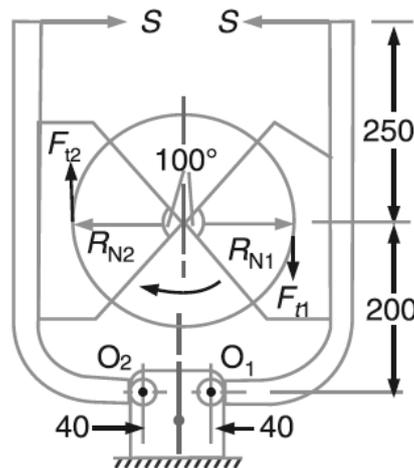
- (c) Two mating involute gears of  $20^\circ$  pressure angle have a gear ratio of 2. The number of teeth on pinion is 20 and speed is 250 rpm. Take module as 12 mm. If the addendum on each wheel is such that the path of approach and path of recess on each side are half of the maximum possible length each. Find:

- Addendum for pinion and gear
- Length of arc of contact
- Maximum velocity of sliding

7. Attempt any *two* parts of the following:

5 x 2 = 10

- (a) A double shoe brake, as shown in Figure, can absorb a torque of 1400 N-m. The diameter of the brake drum is 350 mm and the angle of contact for each shoe is  $100^\circ$ . If the coefficient of friction between the brake drum and lining is 0.4; find 1. the spring force necessary to set the brake; and 2. the width of the brake shoes, if the bearing pressure on the lining material is not to exceed 0.3 N/mm



All dimensions in mm.

- (b) Derive the relation between tension on tight and slack side of V- belt.
- (c) What is the difference between absorption and transmission dynamometers? Explain the working of any dynamometer with neat sketch.