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**B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019**

Fourth Semester

**ME16401 – KINEMATICS OF MACHINERY***(Mechanical Engineering)***(Regulation 2016)****Time: Three Hours****Maximum : 100 Marks**Answer **ALL** questions**PART A - (10 X 2 = 20 Marks)**

	<b>CO</b>	<b>RBT</b>
1. Define Kinematic Pair.	<b>1</b>	<b>U</b>
2. What is Toggle position?	<b>1</b>	<b>U</b>
3. How to represent the direction of linear velocity of any point on a link with respect to another point on the same link?	<b>2</b>	<b>AP</b>
4. What are the methods for determining the velocity of a body?	<b>2</b>	<b>AP</b>
5. Define pressure angle with respect to cams.	<b>3</b>	<b>U</b>
6. What are the different types of high-speed cams.	<b>3</b>	<b>AP</b>
7. Differentiate cycloidal tooth profile with involute tooth profile.	<b>3</b>	<b>AP</b>
8. Where the epicyclic gear trains are used?	<b>3</b>	<b>AP</b>
9. Why self-locking screws have lesser efficiency?	<b>4</b>	<b>AP</b>
10. State the law of belting.	<b>4</b>	<b>U</b>

**PART B - (5 X16 = 80 Marks)**

11. (a) Sketch and explain the various inversions of a single slider crank chain. **(16)** **1** **U**

**(OR)**

- (b) Describe the mechanism obtained by inversions of four bar chain. **(16)** **1** **U**

12. (a) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm. The crank is 150 mm and the connecting rod is 600 mm long. Determine: 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position. **(16)** **2** **AP**

**(OR)**

- (b) PQRS is a four bar chain with link PS fixed. The lengths of the links are  $PQ = 62.5$  mm;  $QR = 175$  mm;  $RS = 112.5$  mm; and  $PS = 200$  mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle  $QPS = 60^\circ$  and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS. (16) 2 AP
13. (a) A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below: (16) 3 AN
1. To raise the valve through 50 mm during  $120^\circ$  rotation of the cam;
  2. To keep the valve fully raised through next  $30^\circ$ ;
  3. To lower the valve during next  $60^\circ$ ; and
  4. To keep the valve closed during rest of the revolution i.e.  $150^\circ$ ;
- The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of the stroke is offset 15 mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion.

(OR)

- (b) A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below: (16) 3 AN
1. To move outwards through 40 mm during  $100^\circ$  rotation of the cam;
  2. To dwell for next  $80^\circ$ ;
  3. To return to its starting position during next  $90^\circ$ , and
  4. To dwell for the rest period of a revolution i.e.  $90^\circ$ .
- Draw the profile of the cam
- (i) when the line of stroke of the follower passes through the centre of the cam shaft, and
  - (ii) when the line of stroke of the follower is off-set by 15 mm. The displacement of the follower is to take place with uniform acceleration and uniform retardation.
- Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 rpm.
- Draw the displacement, velocity and acceleration diagrams for one complete revolution of the cam.

14. (a) Two mating gears have 20 and 40 involute teeth of module 10 mm and  $20^\circ$  pressure angle. The addendum on each wheel is to be made of such a length that line of contact on each side of pitch point has half the maximum possible length. Determine the addendum height for each gear wheel, length of path of contact, arc of contact and contact ratio. (16) 3 AP

(OR)

- (b) Figure 14b shows diagrammatically a compound epicyclic gear train. (16) 3 AP  
Wheels A, D and E are free to rotate independently on spindle O, while B and C are compound and rotate together on spindle P, on the end of arm OP. All the teeth on different wheels have the same module. A has 12 teeth, B has 30 teeth and C has 14 teeth cut externally.

Find the number of teeth on wheels D and E which are cut internally.  
If the wheel A is driven clockwise at 1 r.p.s. while D is driven counter clockwise at 5 r.p.s., determine the magnitude and direction of the angular velocities of arm OP and wheel E.

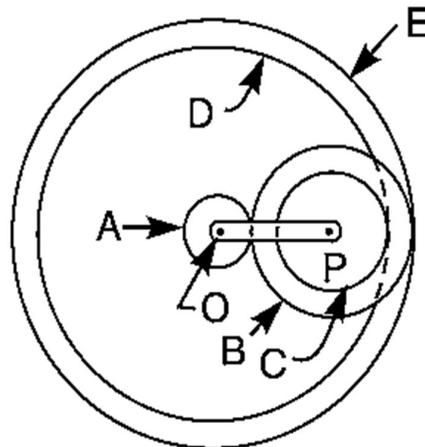


Figure 14b

15. (a) The mean diameter of a square threaded screw jack is 50 mm. The pitch of the thread is 10 mm. The coefficient of friction is 0.15. What force must be applied at the end of a 0.7 m long lever, which is perpendicular to the longitudinal axis of the screw to raise a load of 20 kN and to lower it? (16) 4 AP

(OR)

- (b) Figure 15b shows a brake shoe applied to a drum by a lever AB (16) 4 AP which is pivoted at a fixed-point A and rigidly fixed to the shoe. The radius of the drum is 160 mm. The coefficient of friction at the brake lining is 0.3. If the drum rotates clockwise, find the braking torque due to the horizontal force of 600 N at B.

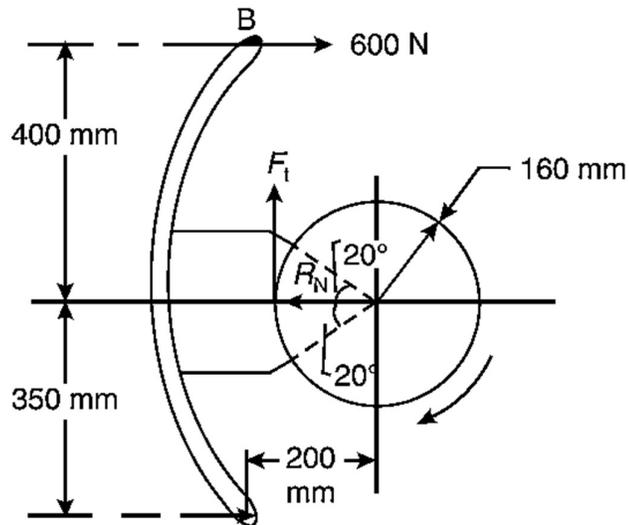


Figure 15b