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B.E / B.TECH. DEGREE EXAMINATION, MAY 2023

Fourth Semester

ME18403 – KINEMATICS OF MACHINERY

(Mechanical Engineering)

(Regulation 2018 / Regulation 2018A)

TIME: 3 HOURS

MAX. MARKS: 100

- CO 1 Students will be able to demonstrate the concepts of mechanisms involved in various applications
- CO 2 Students will be able to design few linkage mechanisms for specified output motion
- CO 3 Students will be able to compute the displacement, velocity and acceleration for planar mechanisms in machines.
- CO 4 Students will be able to recommend the profile in cam and gear mechanisms.
- CO 5 Students will be able to evaluate the motion and the dynamical forces acting on mechanical systems

PART- A (10 x 2 = 20 Marks)

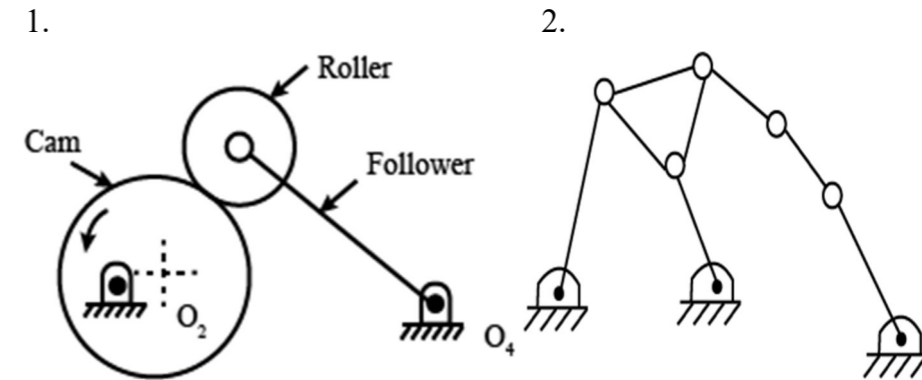
(Answer all Questions)

	CO	RBT LEVEL
1. Identify one mechanism under successful constrained, unsuccessful constrained and completely constrained pair.	1	2
2. What is the significance of the degrees of freedom of a kinematic chain when it functions as a mechanism? Give examples.	2	2
3. State the reason for doing velocity and acceleration analysis for a mechanism	3	2
4. How will you determine the magnitude and direction of Coriolis component of acceleration for a block sliding inside a slotted lever?	3	2
5. What is prime circle of a cam? What is the radial distance between the prime circle and base circle for a cam with roller follower?	4	2
6. Which of the following followers is preferred and why? 1. Roller 2. Knife edge	4	2
7. Which phenomenon occurs when the tip of tooth undercuts mating gear? How to prevent it from occurring?	4	2
8. Brief the type of gear train used in automotive transmissions, lathe back gears, clocks.	4	2
9. Differentiate between sliding and rolling friction	5	2
10. Describe the phenomenon which occurs when belt moves from tight side to slack side and its effect on speed of pulleys.	5	2

PART- B (5 x 14 = 70 Marks)

Marks CO RBT LEVEL

11. (a) (i) Find the degrees of freedom for the following mechanisms

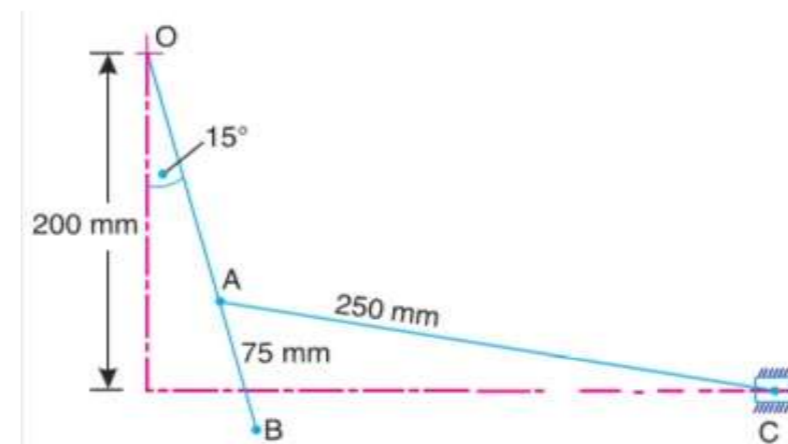


(ii) A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke.

(OR)

(b) Determine the proportions of four bar mechanism, by using three precision points, to generate $y = x^{1.5}$, where x varies between 1 and 4. Assume $\theta_s = 30^\circ$; $\Delta\theta = 90^\circ$; $\phi_s = 90^\circ$; and $\Delta\phi = 90^\circ$. Take the length of the fixed link AD as 25 mm.

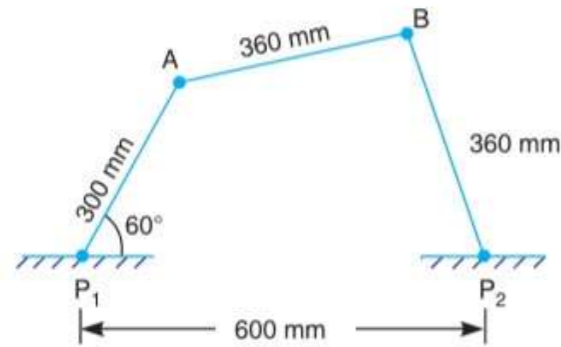
12. (a) The oscillating link OAB of a mechanism is shown below. It is pivoted at O and is moving at 90 r.p.m. anticlockwise. If OA = 150 mm; AB = 75 mm, and AC = 250 mm, calculate 1.the velocity of the block C; 2. the angular velocity of the link AC; and 3. the rubbing velocities of the pins at O, A and C, assuming that these pins are of equal diameters of 20 mm



(OR)

(b) The dimensions and configuration of the four bar mechanism, shown in Figure, are as follows: $P_1A = 300$ mm; $P_2B = 360$ mm; $AB = 360$ mm, and $P_1P_2 = 600$ mm. The angle $AP_1P_2 = 60^\circ$. The crank P_1A has an angular

velocity of 10 rad/s and an angular acceleration of 30 rad/s², both clockwise. Determine the angular velocities and angular accelerations of P₂B, and AB and the velocity and acceleration of the joint B.



13. (a) Design a cam to raise a valve with simple harmonic motion through 50 mm in 1/3 of a revolution, keep it fully raised through 1/12 revolution and to lower it with UAR in 1/6 revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The diameter of the camshaft is 25 mm. The axis of the valve rod is offset by 15 mm to the axis of the camshaft. If the camshaft rotates at a uniform speed of 100 r.p.m.; find the maximum velocity and acceleration of a valve during raising and lowering

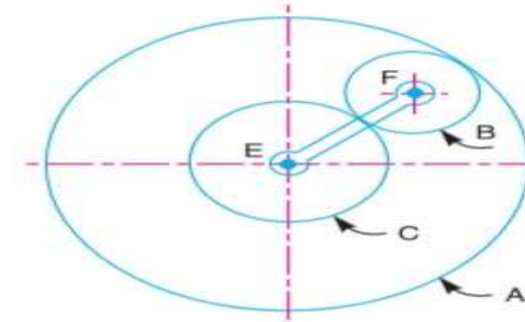
(OR)

- (b) Draw the profile of a disc cam to give cycloidal motion during outstroke of 30 mm to a knife edge follower during first half revolution. Return of cam is also of similar cycloidal motion during remaining half revolution. Minimum radius of the cam is 25 mm. Assume that the axis of knife edge follower passes through cam axis.

14. (a) A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 r.p.m. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point, and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm.

(OR)

- (b) An epicyclic gear consists of three gears A, B and C as shown below. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 r.p.m.. If the gear A is fixed, determine the speed of gears B and C.



15. (a) (i) A 150 mm diameter valve, against which a steam pressure of 2 MN/m² is acting, is closed by means of a square threaded screw 50 mm in external diameter with 6 mm pitch. If the coefficient of friction is 0.12 ; find the torque required to turn the handle. (6) 5 3
- (ii) 100 kW is to be transmitted by a rope drive through a 160 cm diameter 45° grooved pulley running at 200 rpm. Angle of overlap 140° and coefficient of friction between pulley and rope is 0.25. Mass of rope is 0.7 kg/m and it can withstand a tension of 800 N. Considering centrifugal tension, find the following: (i) Number of ropes required, (ii) Initial tension in the rope. (8) 5 3

(OR)

- (b) A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 100 kW at 2400 r.p.m. and maximum torque 500 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plate is not to exceed 0.07 N/mm². The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N/mm, determine the initial compression in the springs and dimensions of the friction plate. (14) 5 3

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

16. Mechanisms producing reciprocating motion is used in shaping and slotting machine. Identify those mechanisms and illustrate them in detail with necessary sketches

Marks	CO	RBT LEVEL
(10)	1	3