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B. Tech 4th Semester Examination

Kinematics of Machines (N.S.)

ME-224

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i)   Attempt five questions in all, selecting one question each from Sections A, B, C & D of the paper and all sub-parts of Q No.9 of Section E.

(ii)   All questions carry equal marks.

(iii)   Use of Non-Programmable calculator is allowed.

SECTION - A

1.   (a)   Show that the locus of the midpoint of the link connecting the two sliders in an elliptical trammel is a circle.   (7)

(b)   Explain the various inversions of single and double slider crank chains.   (13)

2.   (a)   What is coriolis component of acceleration? Explain how to find the magnitude of coriolis acceleration.   (10)

(b)   The crank of a reciprocating engine revolves at a uniform speed of 310 r.p.m. in a clockwise direction. The crank and connecting rod are 15 cm and 65 cm long respectively. Find the velocity of piston for crank positions from 0° to 90° from inner dead centre at intervals of 30°. Plot the velocities on a crank angle base.   (10)

SECTION - B

3. A cam rotating at 150 r.p.m., operating a reciprocating roller follower of radius 2.5 cm. The follower axis is offset by 2.5 cm to the right. The least radius of the cam is 5 cm and the stroke of the follower is 5 cm. Ascent and descent both takes place by uniform acceleration and retardation. Ascent takes place during 75° and descent during 90° of cam rotation. Dwell between ascent and descent is 60°. Draw the cam profile. Also sketch velocity and acceleration diagrams and mark salient values.   (20)

4. (a) Derive the condition of maximum power transmitted by a belt.   (7)

    (b) The cross-sectional area of V-belt driving a 300 mm diameter pulley (angle of groove 30°) is 750 mm^2. The angle of lap is 180° and the pulley runs at 1500 r.p.m. The density of the belt material is 1.2 × 10^{-6} kg/mm^3 and μ =0.12. If the safe working stress in the belt is 7.135 N/mm^2, calculate the power which can be transmitted. Also calculate the speed at which the transmitted power would achieve its maximum. What is the value of the maximum power?   (13)

SECTION - C

5. (a) What is interference? Derive the expression for minimum number of teeth on pinion to avoid interference.   (10)

    (b) A 20° invoulte pinion with 20 teeth drives a gear having 60 teeth. Module is 8 mm and addendum of each gear 10 mm. (i) State whether interference occur or not. (ii) Find the length of path of approach and arc of approach if pinion is the driver.   (10)

6. In an epicyclic gear train, the internal wheels A and B and the compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G, E gears with A and C and F gears with B and D. All wheels have the same module and the numbers of teeth are: T_C = 28, T_D = 26,

$T_E = T_F = 18$. (i) Sketch the arrangement; (ii) Find the number of teeth on A and B; (iii) If the arm G makes 100 r.p.m. clockwise and A is fixed , find the speed B; (iv) If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise, find the speed of wheel B.   (20)

SECTION - D

7. (a) Compare the two and three position synthesis of four bar mechanism.   (10)

    (b) Design a four-bar mechanism so that $\theta_{12} = 45°$ and $\phi_{12} = 55°$. Both input and output cranks should move in the counter clockwise direction.   (10)

8. Synthesize an offset slider-crank mechanism so that the displacement of the slider is proportional to the square of the crank rotation in the interval of $45° \leq \theta \leq 135°$. The distance of the slider from the crank shaft, S, should be 10 cm for $\theta = 45°$ and 3 cm for $\theta = 135°$. Use three Chebyshev's accuracy points.   (20)

SECTION - E (Compulsory Question)

9. Write short answers of the following:

    (a) Explain steering mechanisms.

    (b) State Aronhold-Kennedy Theorem of three centres.

    (c) Compare Involute and Cycloidal tooth profile.

    (d) What is Freudenstein's Equation?

    (e) Explain initial tension in belt with the help of mathematical equation.

    (f) Define velocity ratio and train value for gear trains.

    (g) What are the various methods of locating Instantaneous Centre?

    (h) Explain different types of followers.

    (i) What are the binary, ternary and quaternary links?

    (j) Explain transmission angle in slider crank mechanism.
                                                    (2×10=20)