KINEMATICS OF MECHANISMS

Course Code: 13ME1114

Pre requisites: Engineering Mechanics

Course Educational Objectives:

To make the student

- Aware of the basic elements of machines and their relevant theory
- Identify the underlying mechanism in a given machine
- Determine graphically and analytically, in a given mechanism, quantities like velocity, acceleration
- Recognize the relative merits and demerits of tooth forms like involute tooth form, cycloidal form

Course Outcomes:

The student will be able to

- Identify and analyze the kinematic chain in a given machine
- Be familiar with various practical mechanisms like quick-return, crank-rocker, straight-line motion, steering gears, Hooke’s joint
- Determine, graphically and analytically, the velocities and accelerations in any simple mechanism
- Synthesize a suitable cam profile for a desired follower motion
- Analyze a given belt drive and a gear drive

UNIT-I (12 Lectures)

SIMPLE MECHANISMS:

Link or element – types of links – rigid, flexible and fluid links – kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs, types of constrained motion – completely, incompletely and successfully constrained motion
Kinematic chain - mechanism – inversion – types of kinematic chains –
four bar or quadric cycle chain – single slider crank chain – double slider
 crank chain and their inversions.

**UNIT-II (12 Lectures)**

**MECHANISMS WITH LOWER PAIRS:**
Pantograph – straight line motion mechanisms – exact straight line motion
mechanisms made of turning pairs – Peaucellier mechanism, Hart‘s mechanism – exact straight line motion consisting of one sliding pair -
Scott Russel mechanism – approximate straight line motion mechanisms
- Grass hopper – Watt –Chebyshev -Robert mechanism- steering
mechanism - condition for correct steering – Davis steering gear-Ackerman
steering gear. Hooke’s joint – ratio of shaft velocities – maximum and
minimum speed of driven shaft – condition for equal speeds – Angular
acceleration of driven shaft – Double Hooke’s joint.

**UNIT-III (12 Lectures)**

**VELOCITY IN MECHANISMS:**
Relative velocity method – velocity of point on a link- application of
relative velocity method to four bar mechanism and slider crank mechanism
– rubbing velocity of a joint – instant centre method –velocity of point
on a link by instant centre method, location of instant centre – Kennedy-
Arnhold theorem and its application to simple mechanisms.

**ACCELERATION IN MECHANISMS:**
Acceleration diagram of a link - acceleration diagram for a four bar
mechanism and slider crank mechanism - analytical expression for the
determination of velocity and acceleration of the piston of a reciprocating
engine - Coriolis component of acceleration - acceleration diagram for
crank and slotted-lever quick-return mechanism.

Analytical expressions for displacement, velocity and acceleration for
four-bar mechanism.

**UNIT-IV (12 Lectures)**

**CAMs:**
Classification of followers and cams – terms used in radial cams –
displacement, velocity and acceleration diagrams when the follower moves
with uniform velocity, uniform acceleration and retardation, simple harmonic motion – construction of cam profiles – cams with specified contours – tangent cam with roller follower – circular arc cam with flat faced follower.

**BELT DRIVES:**
Types of belt drives, materials used for belts, slip and creep in belt drives, length of belt in open and crossed belt drives, ratio of belt tensions in flat and V- belt drives – initial tension, centrifugal tension, maximum tension in belt, condition for transmission of maximum power.

**UNIT-V**  
(12 Lectures)

**TOOTHED GEARING:**
Classification of toothed wheels – terms used in gears - law of gearing – velocity of sliding of teeth – forms of teeth – cycloidal and involute teeth – standard proportions of gear teeth – length of arc of contact – path of contact – contact ratio- interference in involute teeth - minimum number of teeth to avoid interference. Introduction to helical and spiral gears.

**GEAR TRAINS:**

**TEXT BOOK:**

**REFERENCES:**