

II YEAR II SEM

15AME16-KINEMATICS OF MACHINERY

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Course Objectives:

On completing the course, the student will be able to:

- Understand the fundamentals of the theory of kinematics and dynamics of machines.
- Understand techniques for studying motion of machines and their components.
- Use computer software packages in modern design of machines.

UNIT – I

Mechanisms And Machines: Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain – single and double slider crank chain. Mobility of mechanisms.

UNIT-II

Straight Line Motion Mechanisms- Exact and approximate, copied and generated types – Peaucellier, Hart and Scott Russel, Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph.

Steering Mechanisms: Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke's Joint (Universal coupling) -Single and double Hooke's joint — applications – Simple problems.

UNIT – III**Kinematics**

Velocity and Acceleration Diagrams- Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, Coriolis acceleration, determination of Coriolis component of acceleration. Kleins construction. Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method

Instantaneous Centre Method: Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centres in-line theorem – Locating instantaneous centres for simple mechanisms and determination of angular velocity of points and links.

UNIT – IV

Gears: Higher pairs, toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Forms of tooth- cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference. Condition for minimum number of

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teeth to avoid interference, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and Worm gearing.

Gear Trains: Introduction –Types of gears – Simple, Compound, Reverted and Epicyclic gear trains, Train value – Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile.

UNIT – V

Cams: Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity, Simple harmonic motion, Cycloidal and uniform acceleration–and retardation Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.

Analysis Of Motion Of Followers: Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower.

Text Books :

1. Theory of Machines, S.S. Rattan, Tata McGraw Hill Publishers.
2. The Theory of Machines, J.E. Shigley, McGraw Hill .
3. Theory of Machines, Thomas Bevan, CBS.

References :

1. Theory of Machines, R.K.Bansal and J S Brar, Laxmi Publications.
2. Mechanism and Machine Theory, J.S. Rao and R.V. Dukkipati, New Age
3. Theory of machines, P.L. Ballaney, Khanna Publishers.
4. Kinematics and dynamics of machinery, R.L Norton ,Tata McGraw Hill Publishers

Course Outcomes

Upon successful completion of this course, the student will be able to:

- Distinguish kinematic and kinetic motion.
- Identify the basic relations between distance, time, velocity, and acceleration.
- Apply vector mechanics as a tool for solving kinematic problems.
- Create a schematic drawing of a real-world mechanism.
- Determine the degrees-of-freedom (mobility) of a mechanism.

Suggestions:

Students may visit nearby machine tool shops and automobile workshops to know about different mechanisms, gears, gear trains, flexible drives and cams. Students are suggested to search the web and identify different URLs which provide animations of mechanisms for better visualization and understanding purpose.


Web References :

<http://nptel.iitk.ac.in>

<http://ptumech.loremate.com/tom1/node/1>

<http://www.youtube.com/watch?v=6coD3oOuhr8>

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