ME4T4   **KINEMATICS OF MACHINERY**   **Credits: 4**

Lecture:- -4 periods/week   **Internal assessment: 30marks**
Tutorial: - 1 periods/week   **Semester end examination: 70 marks**

Objectives:

1. Comprehend the fundamentals of kinematics. And to understand the concept of machines, mechanisms and related terminologies.
2. Discriminate mobility (number of degrees-of-freedom). Enumeration of rigid links and types of joints within mechanisms. To make the students become familiar and understanding of the most commonly used mechanisms (4-bar, 6-bar linkages, and cams).
3. Formulate the concept of synthesis and analysis of different mechanisms. To understand the Principles and working of various straight line motion mechanisms
4. Distinguish a mechanism for displacement, velocity and acceleration at any point in a moving link this is prerequisite for dynamics of machines. To analyze Steering gear mechanisms and working of hooks joint. To understand the working principles in power drives. To understand the theory of gears, gear trains and cams

Learning outcomes:

At the end of course the students will be able to:

1. Build up critical thinking and problem solving capacity of various mechanical engineering problems related to kinematics of machines.

2. Asses various concepts of mechanisms like straight line motion mechanisms, Steering gear mechanisms and working principles of power elements (Gears, gear trains, Cams, Belt and Chain drives) and design related problems effectively.

3. Utilize analytical, mathematical and graphical aspects of kinematics of Machines for effective design.

Pre-Requisite subjects:

Engineering Graphics, Engineering Mechanics.

UNIT – I
INTRODUCTION :
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 .

MACHINES : Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

UNIT - II
STRAIGHT LINE MOTION MECHANISMS:
Exact and approximate copiers and generated types –Peaucellier, Hart and Scott Russul – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and Straight line motion, Pantograph.

UNIT – III
KINEMATICS:
Velocity – Motion of link in machine – Determination of Velocity diagrams- Graphical method – Application of relative velocity method four bar chain. Analysis of slider crank chain for displacement, velocity diagram of slider given mechanism.

ACCELERATION ANALYSIS: Acceleration, Four-Link Mechanism, Angular acceleration of Links, Acceleration of Intermediate and offset points, slider-Crank Mechanism, corrilies component of acceleration.

PLANE MOTION OF BODY: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

UNIT-IV
STEERING MECHANISMS:
Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio. HOOKE'S JOINT: Single and double Hooke's joint – Universial coupling – application – problems.

UNIT-V
CAMS:
Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Derivatives of Follower motion - High speed cams - circular arc and tangent cams.

UNIT-VI
GEARS :
Introduction, Classification of gear terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth, Cycloidal Profile Teeth, Involute Profile Teeth, Path of contact, Arc of contact, Number of pairs of Teeth in contact, Interference in Involute Gears, Minimum number of Teeth, Undercutting, Comparison of Cycloidal and Involute tooth forms.

UNIT – VII
BELT ROPE AND CHAIN DRIVES :
Introduction, Belt and rope drives, selection of belt drive- types of belt Drives,V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

UNIT-VII
GEAR TRAINS:
Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train, Torques in Epicyclic Trains. Tabular Method.

Learning resources

Text books:

1. Theory of Machines, (3 ^{ed} Edition) by S.S.Rattan, Tata Mc-Graw Hill, New Delhi, , 2012.
2. Theory of machines, (4th Edition), by R.S. Khurmi, S.chand Publications, 2011.
3. Theory of machine and Mechanisms, 2nd Edition by J.E. Shigley, Mc-Graw Hill, New Delhi,1994.

Reference books:

1. Theory of Mechanisms and Machines, (Ist Edition) by C S Sharma and Kamlesh Purohit , Prentice Hallof India pvt.ltd, , New Delhi, 2006.
2. Theory of Machines, (3^{ed} edition),by   Ballaney, P.L, Khanna Publishers, New Delhi 2002.
3. Theory of Mechanisms and Machines, (2nd Edition), by A. Ghosh and ak Mallik, East-West Press (P) Ltd., New Delhi, , 1988.