KINEMATICS OF MACHINERY

B.Tech. II Year II Semester

Course Code	Category	Hours/ Week			Credits	Maximum Marks		
		L	**T**	**P**		**CIA**	**SEE**	**TOTAL**
ME2202PC	**Core**	**3**	**1**	**0**	**4**	**25**	**75**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Engineering Mechanics

I. COURSE OVERVIEW:

Mechanical devices are designed to have mobility to perform certain functions. The theory behind the study of Kinematics of Machine emphasizes to design machines by understanding the relationship between the geometry and the motion of various parts of machine. This course will provide the knowledge on how to analyze the motions and design synthesis of mechanisms to give required mobility. This includes relative motion analysis and design of gears, gear trains, cams, linkages and steering mechanism by adopting both graphical and analytical approaches to estimate displacement, velocity and acceleration of links in a machine.

II. COURSE OBJECTIVES:

i. Comprehend the fundamentals of kinematics. And to understand the concept of machines, mechanisms and related terminologies.

ii. To understand the principles in analyzing the kinematics from the geometric point of view to determine mobility, velocity and acceleration using graphical methods.

iii. To understand the mechanisms with lower pairs to obtain steering, copying and straight line motions in automobiles and other allied applications.

iv. To understand the kinematic analysis of cams (higher pairs) imparting motion to knife edged, roller and mushroom followers.

v. To understand the basic concepts of toothed gearing and kinematics of gear trains in motion transmission and in machine components.

III. COURSE OUTCOMES:

CO1: Differentiate and evaluate the performance of different mechanisms with their inversions.

CO2: Evaluate and compute the velocity and acceleration associated with operation of links in kinematic chain by applying graphical method.

CO3: Interpret the straight line motion mechanisms, also can choose the correct steering mechanisms for automobiles. And can evaluate the velocity ratios of Hooke's joint in automotive applications.

CO4: Develop cam profiles for different follower motions and analyze the performance of followers.

CO5: Analyze the concept of law of gearing to evaluate the gear tooth geometry and can compute the velocities of gear trains at different conditions.

IV. COURSE SYLLABUS:

UNIT – I

Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs –closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.

Mechanism and Machines – Mobility of Mechanisms: Grubler's criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

UNIT – II

Kinematics: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

Plane motion of body: Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration.

Analysis of Mechanisms: Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

UNIT – III

Straight-line motion mechanisms: Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism - Pantographs

Steering gears: Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.

Hooke's Joint: Single and double Hooke's joint –velocity ratio – application – problems.

UNIT – IV

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 and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Analysis of motion of followers: Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

UNIT – V

Higher pair: Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding.
Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

Gear Trains: Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile.

TEXT BOOKS:

1. Theory of Machines and Mechanisms/JOSEPH E. SHIGLEY/ Oxford
2. Theory of Machines / S. S. Rattan / Mc Graw Hill Publishers.

REFERENCE BOOKS:

1. Theory of Machines / Sadhu Singh / Pearson.
2. Theory of Machines / Thomas Bevan/CBS.