



MARRI LAXMAN REDDY

INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(AN AUTONOMOUS INSTITUTION)

(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)

Accredited by NAAC with 'A' Grade & Recognized Under Section 2(f) & 12(B) of the UGC act, 1956

COURSE CONTENT

KINEMATICS OF MACHINERY								
IV Semester: ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2540320	Foundation	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			
Prerequisites: Basic principles of Mechanics								

Course Overview:

The Kinematics of Machinery course provides an in-depth study of mechanisms, motion analysis, and machine components essential for mechanical engineering applications. It begins with fundamental concepts, including kinematic pairs, degrees of freedom, and various mechanisms such as four-bar chains, steering mechanisms, and straight-line motion mechanisms. The course progresses to kinematic analysis using graphical and analytical methods, including velocity, acceleration, and mechanical advantage. It also covers cams, gears, gear trains, and their motion characteristics. This subject equips students with analytical and problem-solving skills for designing and optimizing mechanical systems.

Course Objective:

1. To introduce the concept of machines, mechanisms and related terminologies and the relative motion, velocity, and accelerations of the various elements in a mechanism.
2. To make the students become familiar with the most commonly used mechanisms such as fourbar, slider crank, double slider crank mechanisms and their inversions.
3. To provide an overview of straightline motion mechanisms, steering mechanisms and Hooke's joint.
4. To familiarize higher pairs like cams and principles of cams design.
5. To understand the kinematic analysis of gears and gear trains.

Course Outcomes: After successful completion of the course, students should be able to

1. Understand the various elements in mechanism and the inversions of commonly used mechanisms such as four bar, slider crank and double slider crank mechanisms.
2. Draw the velocity and acceleration polygons for a given configuration of a mechanism
3. Understand the conditions for straight line motion mechanisms, steering mechanism and the usage of Hooke's joint.
4. Draw the displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Calculate the number of teeth and velocity ratio required for a given combination of gears.

UNIT - I

[09]

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 mechanism – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

UNIT -II:

[10]

Kinematic Analysis: Displacement, velocity and acceleration analysis of simple mechanisms graphical method (slider crank, four bar and toggle mechanism), Relative Velocity, Rubbing Velocity, Mechanical Advantage, instantaneous centre method (slider crank, four bar and toggle mechanism)- Aronhold Kennedy Theorem, Kliens construction - Coriolis component of acceleration.

UNIT -III:

[10]

Straight line motion mechanisms, steering gears, hooke's joint

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.

UNIT -IV:

[10]

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:

[9]

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 involute 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. Kinematic analysis and synthesis of mechanisms: by Mallik, A. K., Ghosh, A., & Dittrich/ G CRC Press/ 10th Edition, 2008.
2. Theory of Machines by Rattan.S.S. McGraw-Hill Education (India) Pvt Ltd./ 6th Edition/ 2013.

REFERENCE BOOKS:

1. The theory of machines: A Text-Book for Engineering Students: by Bevan T/ Pearson Education/ 4th Edition/ 2013.
2. Fundamentals of kinematics and dynamics of machines and mechanisms: by Vinogradov, O. G./ CRC Press/ 2nd Edition/ 2014.
3. Theory of Machines: Kinematics and Dynamics by Sadhu Singh/Pearson Education/3th Edition/2018.

ELECTRONIC RESOURCES:

1. <https://nptel.ac.in/courses/112104121>
2. <https://nptel.ac.in/courses/112105268>
3. <https://www.youtube.com/watch?v=yDEJxYGAoso>
4. <http://www.digimat.in/nptel/courses/video/112104121/L01.html>

MATERIALS ONLINE:

1. Course template
2. Assignments
3. Model question paper – I
4. Model question paper – II
5. Lecture notes
6. E-Learning Readiness Videos (ELRV)

