



# GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

## KINEMATICS OF MACHINERY

Course Code: GR15A2019  
II Year I Semester

L:3 T:1 P:0 C:4

**Prerequisites:** Engineering Mathematics

### Course Objectives

- To introduce the concepts of links, mechanisms and machines and study the various straight line motion mechanisms.
- To introduce the concepts of analysis of mechanisms regarding velocity, acceleration and explain the concept of instantaneous centres.
- To introduce various cams and follower mechanisms and explain their working principles.
- To introduce the concept of gears, gear terminology, tooth profiles and gear trains.
- To introduce the concept of belts, chains, ropes and steering mechanisms.

### Course Outcomes

- To aware of advantages of different machine elements which might accomplish similar results (such as belts/chains/gears, cam/eccentric).
- Ability to calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms.
- Ability to conduct a complete (translational and rotational) mechanism position analysis.
- Ability to conduct a complete (translational and rotational) mechanism velocity and acceleration analysis.
- Ability to do cam mechanism classification and cam motion profiles, and familiarity with introductory cam design considerations
- Ability to do gear mechanism classification and gear train analysis, and familiarity with gear standardization and specification in design.
- Familiarity with common mechanisms used in machines and everyday life.

### Unit-I

**Mechanisms:** Elements, Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs - Types of constrained motions.

**Machines:** Classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle chain, single and double slider crank chains.



**Straight Line Motion Mechanisms:** Exact, approximate and intermediate types – Peaucellier, Hart and Scott Russell – Grasshopper – Watt -T.Chebicheff and Robert Mechanisms - Pantograph.

### Unit-II

**Kinematics:** Velocity and acceleration–Motion of link in machine –Determination of Velocity and acceleration diagrams–Graphical method –Application of relative velocity method four bar chain.

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement, velocity and acceleration of slider–Acceleration diagram for a given mechanism, Klein's Construction, Coriolis acceleration, determination of Coriolis component of acceleration.

**Plane motion of body:** Instantaneous centre of rotation, centroids and axodes –relative motion between two bodies–Three centres inline theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

### Unit-III

**Cams and Followers:** Definition of cam and follower – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity– Simple harmonic motion and uniform acceleration. Maximum velocity and acceleration during outward and return strokes in the above cases. Analysis of motion of followers - Roller follower – circular cam with straight, concave and convex flanks.

### Unit-IV

**Gears:** Higher pairs, friction wheels and toothed gears – types – Gear Terminology– Law of gearing, Condition for constant velocity ratio for transmission of motion- Form of teeth: Cycloidal and involute profiles - Velocity of sliding – Phenomena of Interference – Condition for minimum number of teeth to avoid interference, Expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.

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

### Unit-V

**Steering Mechanisms:** Conditions for correct steering-Davis Steering gear, Ackerman's steering gear – velocity ratio.



**Hooke's Joint:** Single and double Hooke's joint-Universal coupling-application-problems.

**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.

### Teaching Methodology

White Board and Marker, PPTs, Models

### Text Books

1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers
2. Theory of Machines R.S Khurmi & J.K Gupta

### References Books

1. Theory of Machines by Thomas Bevan/ CBS
2. Theory of Machines / R.K Bansal
3. Theory of Machines Sadhu Singh Pearson's Edition
4. Theory of Machines /Shigley/ Oxford.
5. Theory of machines – PL. Balaney/khanna publishers.
6. Mechanism and Machine Theory / JS Rao and RV Dukupati / New Age