III B. Tech – I Semester

(20ME5008) KINEMATICS OF MACHINERY

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisites: Engineering mechanics

Course Objectives

The Students will acquire the knowledge

- To interpret the mechanisms from the basic concepts for kinematic pairs, joints and mechanisms
- To evaluate the straight-line motion mechanisms and conditions for correct steering
- To interpret the concepts of velocity and acceleration diagrams for the applications of various mechanisms
- To analyze cams for producing a desired motion and cams with specified contours and belt and rope drives for the rated conditions of the machines.
- To find the efficiency of different types of gears for automobile and machine tools

UNIT–I: Mechanisms

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. Grashoff's law, Degrees of freedom, Kutzbach criterian for planar mechanisms, Mechanism and machines–classification of machines – kinematic chain–inversion of mechanism – inversions of quadric cycle chain – single and double slider crank chains.

UNIT–II: Lower Pair Mechanism

Exact and approximate copiers and generated types – Peaucellier, Hartand Scott Russul–
Grasshopper – Watt T.Chebicheff and Robert Mechanisms and straight-line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackerman's steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling–application–problems.

UNIT–III: Kinematics

Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Klein's construction, determinationofCorioliscomponentofacceleration.PLANEMOTIONOFBODY: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: 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: Roller follower–circular cam with straight, concave and convex flanks.

Belt 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–V: Gears
Higher pairs, friction wheels and toothed gears–types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods 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 to gear Trains, 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 for an automobile.

Course Outcomes:

A student who successfully fulfills this course requirement will be able to:

S. No	Course Outcome	BTL
CO1	Interpret the mechanisms from the basic concepts for kinematic pairs, joints and mechanisms	L2
CO2	Evaluate the straight line motion mechanisms and conditions for correct steering	L2
CO3	Interpret the concepts of velocity and acceleration diagrams for the applications of various mechanisms	L2
CO4	Analyze cams for producing a desired motion and cams with specified contours	L4
CO5	Find the efficiency of different types of gears for automobile and machine tools	L4

Correlation of Cos with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	1	1	2	1	1	3	3	2
CO2	3	3	3	3	3	3	1	1	2	1	1	3	2	2
CO3	3	3	3	3	3	3	1	1	1	1	1	3	3	1
CO4	3	3	3	3	3	3	1	1	1	1	1	3	3	2
CO5	3	3	3	3	3	3	1	1	1	1	1	3	3	2

Textbooks:

1. Theory of Machines & Mechanisms - P.L Ballaney - Khanna Publishers
2. Theory of Machines by Thomas Bevan / CBS Publishers

References:

1. Theory of Machines – S.S Rattan - TMH Publishers
2. Theory of Machines and Machinery / Vickers / Oxford .
3. Theory of Mechanisms and machines – A.Ghosh & A.K.Malik–East West Press Pvt. Ltd.
4. Kinematics and dynamics of Machinery by R.LNorton; TATA Mc Graw - Hill

Course Outcomes:

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

1. Interpret the mechanisms from the basic concepts for kinematic pairs, joints and mechanisms (BL-2)
2. Evaluate the straight line motion mechanisms and conditions for correct steering
3. Interpret the concepts of velocity and acceleration diagrams for the applications of various mechanisms
4. Analyze cams for producing a desired motion and cams with specified contours
5. Find the efficiency of different types of gears for automobile and machine tools