

PE208: KINEMATICS OF MACHINES
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

To explore many aspects of the Theory of Machines, develop skill of finding analytical & graphical solution of given problem of motion characteristics for a given mechanism and make the student understand about basics of Kinematics of Machines.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory		Practical		
			ESE	CE	ESE	CE	150	
3	0	2	5	70	30	30		20

Course Contents:

Unit No.	Topics	Teaching Hours
1	<p><u>Basic Concept of Mechanisms & Machines:</u> Subject Introduction, Mechanism and Machine, Types of motions, Rigid and Resistant Bodies, Link, Kinematic Pair, Related Terminology/Definitions, Classification of Kinematic Pairs, Kinematic Chain, Linkage, Mechanism, & Structure, Mobility of Mechanisms, Degrees of Freedom, Inversion of Four-Link(Bar) Mechanism, Inversion of Single & Double Slider Crank Chain, Transmission Angle & its Importance in Mechanisms.</p>	06
2	<p><u>Motion Analysis in Mechanisms:</u> Introduction, Motion of link, Four-link Mechanisms, Angular Velocity of links, Velocity of Rubbing, Velocity & Acceleration Polygons(Graphical method/Relative Velocity Method), Instantaneous Centre Method of Velocity, Notation, Number of I-centers Kennedy's Theorem, Location of I-Centre, Angular Velocity Ratio Theorem, Introduction to Acceleration, Acceleration of intermediate and offset points on Slider Crank Mechanisms & Four Bar Chain Mechanisms, Coriolis Acceleration Component, Quick Return Motion Mechanisms, Klein's Construction Method for Slider Chain and Four Bar Mechanism.</p>	07

Unit No.	Topics	Teaching Hours
3	<p><u>Lower Pair Mechanisms:</u> Pantograph, Concept & Principles of Straight Line Mechanism & Approximate Straight Line Mechanisms like Paucellier, Hart's Mechanism, Watt's Mechanism, Tchebicheff Mechanism, Modified Scott-Russel & Robert's Mechanisms, Engine Indicators, and Steering Gear Mechanisms: Davis & Ackerman Mechanisms, Hooke's Joint & its analysis, condition of equal speed, Double Hook's Joint.</p>	06
4	<p><u>Cams & Cam-follower Mechanism:</u> Introduction, Definition of Cam & Followers, Uses of Cam-Follower Mechanism, Types of Cams, Types of Followers, Nomenclature/Terms used in Cam-Follower Mechanisms, Displacement Diagrams, Motions of the Follower, Layout of the Cam Profiles (synthesis), Analysis of Cams with Specified Contours: -Tangent Cam with Roller Follower & Flat Faced Follower, Design of Cams.</p>	07
5	<p><u>Kinematic Synthesis of Mechanisms:</u> Types of Synthesis, Type, Number & Dimensional Synthesis, Stages in Kinematic Synthesis, Approximate & Exact Synthesis, Function Generation & Path Generation, Structural Errors, Chebyshev's Spacing of Accuracy or Precision Points, Names of methods of solving a synthesis problem, Frudenstein Equation, Analytical Methods for Dimensional Synthesis of Four-bar Chain Mechanism & Slider Crank Chain Mechanism, Graphical Methods of Dimensional Synthesis for Four-bar Chain Mechanism & Slider Crank Chain Mechanism (poles & relative poles).</p>	08
6	<p><u>Flexible Power Transmission System:</u> Belt drive: Introduction, Belt & Ropes Drives, Selection Criteria, Types of belt drives, Materials used for Belt & Rope Drive, Wire Rope, Slip & Creep of Belt, Tensions for flat belt, Angle of contact, Centrifugal tension, Maximum tension in belts. Chain drive: Chains, Chain length, Angular speed ratio, Classification of chains. Rope drives: Types, Applications, Limitations, etc. Gears & Gear Drive: Definition, Types of gears, Gear trains, Applications of gear drive.</p>	10
TOTAL		44

List of References:

1. S.S. Rattan, "*Theory of Machines*", Tata McGraw Hill Publication Company Limited, New Delhi.
2. Shigley J.E. & Uicker J.J., "*Theory of Machines & Mechanisms*", McGraw-Hill International Book Co.
3. Rao J.S. & Duggipati R.V., "*Mechanisms & Theory of Machines*", Wiley Eastern Ltd.
4. Wilson, "*Kinematics & Dynamics of Machinery*", 3rd Edition, Pearson Education
5. Ashok G. Ambekar, "*Mechanisms & Machine Theory*", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi.
6. Bevan Thomas, "*Theory of Machines*", Pearson Education India
7. Mabie H. H. & Ocvirk, F.W., "*Kinematic and Dynamics of Machinery*", 3rd Edition, John Wiley & Sons.
8. Green W.G., "*Theory of Machines*", London: Blackie (1964).

Course Outcomes (COs):

At the end of this course students will be able to

1. Learn more about the analysis of motion types given to machine parts (rigid bodies).
2. Evaluate a given component/machine member or mechanism of a specific type in terms of displacements, velocities and accelerations by analytical & graphical methods.
3. Calculate the degree of freedom, decide state of mechanisms by movability concept & learn to make of models based on existing mechanisms taught.
4. Determine the suitability of a particular mechanism such as belt-rope drives and gear drive for an application by considering various aspects of kinematics.
5. Synthesize the simple mechanisms as well as cam-follower mechanisms to get desired motion characteristics.