

Subject Code: 1ET1010302	Subject Title: Kinematics of Machines
Pre-requisite Subject	Basic concepts of mechanics and Zeal to learn the subject.

Course Objective:

This course will help student to

1. Familiarize with common mechanisms and carryout mobility and motion analysis of mechanisms.
2. Understand gears and analyze gear train.
3. Emphasize the concept of power transmitting drives
4. Understand various cam motion profiles and follower mechanism, analyze cam motions.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total (T+P)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
4	-	2	5	70	30	30	20	150

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
01	Mechanisms And Machines: Basic Kinematic Concepts: Terminology and Definitions, Mechanism & Machines. rigid and resistance body, link, Kinematic pair and its classification, Types of motion, degrees of freedom, Kinematic Chain and Mechanism, Kinematic Inversion. Mechanisms with Lower pairs: Pantograph, Straight line mechanism and approximate straight line mechanism such as Paucellier, Hart's mechanism, Watt, Modified Scott-Russel, Grasshoper, Robert's mechanism. Hooke's Joint, it's analysis, condition for equal speed of driven and driver shafts, Double Hooks Joint, Quick return mechanisms, Steering gear mechanisms such as Davis and Ackermann Steering gear.	10	20	
02	Velocity Analysis: Vectors, Displacement of a rigid body, Relative displacement, Definition of velocity, Angular velocity, Rotation of a rigid body, Translation and rotation of a rigid body, Relative velocity method (graphical), Instantaneous axes of motion, Properties of instantaneous centers, The Kennedy theorem of three centers, Velocity analysis of simple mechanisms by instantaneous centers.	08	16	
03	Acceleration Analysis: Definition of acceleration, Angular acceleration, A general case of acceleration, Radial and transverse components of acceleration, The coriolis component of acceleration, Klein's Construction, Examples of acceleration analysis, Acceleration diagrams.	08	16	
04	Belts, Ropes & Chains: Introduction, Belt and rope drives, Open and crossed belt drives, Velocity	08	16	

	ratio, Slip, Materials for belt and ropes, Law of belting, Length of belt, Ratio of friction tensions, Power transmitted, Centrifugal effect on belts, Maximum power transmitted by a belt, Initial tension, Creep. Chains, Chain length, Angular speed ratio, Classification of chains.		
05	Gears And Gear Trains: Introduction, Classification of gears, Gear terminology, Law of gearing, Velocity of sliding, Forms of teeth, Cycloidal and Involute profile Teeth, Comparison of cycloidal and involute tooth forms, Birth of contact, Arc of contact, number of pairs of teeth in contact, Interference in involute gears, Minimum number of teeth, Interference between rack and pinion, Undercutting, Introduction to helical, Spiral, Worm, Worm gear and bevel gears. Gear trains – simple, compound, epicyclic and reverted. Differentials, automotive transmission gear trains.	08	16
06	Cams: Classification and terminology of cams and followers, different motions of the follower. Pressure angle and undercutting, Displacement Diagrams, Cam profiles for radial and offset followers, cams with specified contours - tangent cam with reciprocating roller follower, circular arc cam with flat faced follower, Graphical construction of cam profile.	08	16

Course Outcome:

The students will be able to

1. Identify mechanisms with basic understanding of motion.
2. Choose the gear trains for a different speed and torque transmission.
3. Assimilate and choose among rope, belt and chains and its use in power transmission.
4. Design and evaluate the performance of different cams and followers.

List of References:

1. Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi
2. Sadhu Singh, "Theory of Machines", Pearson Education, Singapore.
3. Ghosh, A, and Malick, A. K, "Theory of Mechanisms and Machines", East West Press Pvt. Ltd.
4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi.
5. Shigley, J.E. and Uicker, J.J. and Pennock, G. R., "Theory of Machines and Mechanisms", Oxford University Press.
6. Bevan Thomas, "Theory of Machines", Pearson Education Publishers.

List of Practical:

1. To study various types of Links, Pairs, Chain and Mechanism.
2. To study inversion of four Bar Mechanism, Single Slider Crank Chain Mechanism and Double Slider Crank Chain Mechanism.
3. To draw velocity diagram of given mechanism by I-center method.

4. To draw velocity and acceleration diagrams by relative velocity method.
5. To find out velocity and acceleration of various links/points in slider-crank mechanism by Klein's construction method.
6. To study various kinds of belts, rope and chain drives.
7. To study differential gear box of an automobile.
8. To study various types of gears and gear trains.
9. To study various types of Cam and Follower arrangement.
10. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.