B.E Semester: 3 Mechanical Engineering
Subject Name: Kinematics of Machines   (MA306-N)

A. Course Objective:
• To present a problem oriented in depth knowledge of Kinematics of Machines.
• To address the underlying concepts and methods behind Kinematics of Machines.

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
4	0	2	6	5	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	**Mechanism & Machines:** Terminology and Definitions, Mechanism & Machines. rigid and resistance body, link, Kinematic pair Types of motion, degrees of freedom, classification of Kinematic pairs, Kinematic Chain, Linkage, Mechanics, Kinematic Inversion of Single and Double slider crank Chain, Four bar Chain Mechanism with lower pairs, 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.
2	**Velocity and Acceleration** Displacement, velocity and acceleration and analysis in simple mechanisms, Graphical Method velocity and acceleration polygons, Instantaneous Centre of Velocity, Kennedy Theorem, Angular velocity ratio theorem, Kinematic analysis by Algebric methods, Vector Approach, Acceleration analysis, Klein's Construction, Coriolis Acceleration. Computer aided Kinematic Analysis of Mechanism like Slider Crank Mechanism, Four-Bar Mechanism
3	**Belts, Ropes, Chains:** Introduction, belt and ropes drives, selection of belt drive, types of belt drives, V-belts, materials used for belt and rope drives, wire rope, Slip and Creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains, Classification, length, angular speed ratio, classification of chains.

4	**Gears & Gear Trains:** Introduction, Classification of Gears, Gear Terminology, Law of Gearing, Velocity of Sliding, Forms of teeth, Cyclodial Profile Teeth, Both of Contact, Arc of the contact, Numbers of pairs teeth in contact, Interference in involutes gears, Minimum Number of teeth, Interference between Rack and Pinion, Under cutting, Comparison of Cyclodial and involutes tooth forms, Efficiency of Helical, Spiral, Worm, Worm Gear, and Bevel Gears. Simple, Compound, Reverted, Epicyclic gear train
5	**Cams:** Introduction, Definitions of cam and followers their uses, Types of Cams, Types of Followers and their motion, Cam Terminology, Displacement Diagrams, Motion of the Followers, Analysis of motion of followers: Roller follower, circular cam with straight, concave and convex, flanks Graphical Construction of the Profile
6	**Synthesis and Analysis of Mechanisms:** Position analysis (Analytical Techniques): Loop closure (Vector Loop) representation of linkages, Position analysis of Four bar, slider crank and inverted slider crank mechanisms, Coupler curves, Toggle and Limit Position, Transmission angle, Mechanical Advantage. Dimensional Synthesis: Definitions of Type, Number and Dimensional Synthesis, Definitions ofMotion, Path and Function generation, precision position, Chebychev spacing, structural error, Freudenstein's equation, two and three position synthesis (function generation only) of four bar and slider crank mechanisms by graphical and analytical methods.

Total hours (Theory):64
Total hours (Practical):32
Total hours:96

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1st , 2nd , 3rd	Unit 1	20%	1
2	4th . 5th , 6th	Unit 2	20%	2
3	7th , 8th , 9th	Unit 3	20%	3
4	10th . 11th . 12th	Unit 4	20%	4
5	13th , 14th , $15^{th,}$ 16th	Unit 5	20%	5,6

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the

	overall internal evaluation.
7	The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.

F. 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 study velocity and acceleration diagram for Slider Crank Mechanism.
4	To study various kinds of belts drives
5	To study various types of Cam and Follower arrangement.
6	To plot follower displacement Vs cam rotation graph for various cam follower arrangement.
7	To study Different types of Gears and Gear trains.

G. Students Learning Outcomes:

1	The student can build up critical thinking and problem solving capacity of various mechanical engineering problems related to Kinematics of Machines.
2	The student can find the applications of all the areas in day to day life.
3	The student can describe the concepts of machines, mechanisms and related terminologies.
5	The student can analyze planar mechanism for displacement, velocity and acceleration graphically.
6	The student can utilize analytical, mathematical and graphical aspects of kinematics of machines for effective design.
7	The student can perform the kinematic analysis of a given mechanism.
8	The student can analyze various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.

H. Text Books & Reference Books:

1	Shigley, J.E and Uicker, J.J: Theory of Machines and Mechanisms, Oxford University Press
2	Rattan S.S.: Theory of Machines Tata McGraw-Hill Publishing Co. Ltd. New Delhi
3	Rao J.S. and Dukkipati R.V: Mechanisms and theory Machines theory, Wiley Eastern Ltd.
4	Mabie H.H and Ocvirk, F.W: Kinematic and Dynamics of Machinery, 3rd Edition John wiley and sons.
5	Green, W.G: Theory of Machines, 2nd Edition, Blackie, London, 1992.
6	Hollowenko, A.R: Dynamics of Machinery, John wiley and sons. Inc. New York, 1955.
7	Wilson, Kinematics and Dynamics of Machinery, 3rd Edition, Pearson Education.
8	Bevan Thomas, Theory of Machines