

Branch Name:	Mechanical Engineering
Program Code:	ET101
Course Name:	Kinematics & Dynamics of Machines
Course Code:	2ET1010405T
Pre-requisite Course:	Engineering Mechanics, Elements of Mechanical Engineering

Course Objective:

1. To describe the common mechanisms and carryout mobility and motion analysis of mechanisms.
2. To develop the analytical skills for velocity and acceleration of any point on a link in different mechanisms.
3. To learn various cam motion profiles and follower mechanism, analyze cam motions.
4. To demonstrate the laws of gearing, types of gears, terminologies of spur gears and analyze the gear trains.
5. To determine unbalance forces and counter them, as these forces may cause adverse effect on the function of the mechanism or machine.
6. To develop a solution oriented approach for any type of vibrations.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
03	03	-	-	03	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No	Topic	Total Hours	Weight (%)
1	Mechanisms and Synthesis of Mechanisms: Mechanism and Machine, Types of Constrained Motion, Rigid and Resistant Bodies, Link, Kinematic Pair, Types of Joints, Degrees of Freedom, Classification of Kinematic Pairs, Kinematic Chain, Linkage, Mechanism and Structure, Four-bar Chain, Inversion of Single and Double Slider Crank Chain, Application of Kutzbach and Grubler's Criterion for Mechanism, Lower Pairs, Straight Line Mechanisms, Types of Steering Gears, Davis Steering Gear, Ackerman Steering Gear, Type, Number and Dimensional Synthesis, Function Generation, Path Generation, and Body Guidance, Chebychev Spacing, Freudenstein's Equation.	10	15
2	Velocity and Acceleration Analysis: Vectors, Motion of a Link, Angular Velocity of Links, Slider Crank Mechanism, Crank and Slotted Lever Mechanism, Instantaneous Centres, Locating Instantaneous Centres, Kennedy's Theorem, Acceleration, Four-link Mechanism, Slider-crank Mechanism, Coriolis Acceleration Components.	06	15

3	Cams: Introduction, Types of Cams, Types of Followers, Cam Terminology, Displacement Diagrams, Graphical Layout of Cam Profiles. Cam Dynamics: Dynamic analysis of force-closed cam follower: Undamped and Damped response, Jump phenomenon: concept, effect of spring force and dead weights.	04	10
4	Gears And Gear Trains: Introduction, Classification of Gears, Gear Terminology, Law of Gearing, Cycloidal Profile Teeth, Involute Profile Teeth, Length of Path of Contact, Arc of Contact, Contact Ratio, Interference in Involute Gears, Minimum Number of Teeth, Undercutting, Helical Gears, Helical Gear Forces and Efficiency, Gear Train: Simple Gear Train, Compound Gear Train, Reverted Gear Train, Epicyclic Gear Train, Sun and Planet Gear Train.	04	10
5	Balancing: Introduction, static balancing, dynamic balancing, transference of force from one plane to another plane, balancing of several masses in different planes, force balancing of linkages, balancing of reciprocating mass, balancing of locomotives, Effects of partial balancing in locomotives, secondary balancing, balancing of inline engines, balancing of v-engines, balancing of radial engines, balancing machines.	06	20
6	Gyroscope: Angular velocity, angular acceleration, gyroscopic torque, gyroscopic effect on naval ships, aero plane, stability of an automobile, stability of two wheel vehicle Critical Speeds of Shafts: Critical speed of shaft carrying single rotor and having no damping, Critical speed of shaft carrying single rotor and having damping, secondary critical speeds in horizontal shafts, critical speed of shaft having multiple rotors.	06	10
7	Free Vibrations and Damped Free Vibrations: Types of vibrations, elements constituting vibration, spring mass system, free undamped vibrations, equation of motion, equivalent spring stiffness, free damped vibrations, equation of motion for viscous damper, damping factor, under damped system, critically damped system, over damped system, logarithmic decrement, free torsional vibration of a two and three rotor system, torsionally equivalent shaft, torsional vibration of a geared system. Forced Damped Vibrations: Analytical solution of forced damped vibration, vector representation of forced vibrations, Magnification factor, force transmissibility, forced vibration with rotating and reciprocating unbalance, forced vibration due to excitation of support, vibration frequency measurement.	10	20

List of Reference Books:

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 Mallick, A. K, "Theory of Mechanisms and Machines", East West Press Pvt. Ltd.
4. Rao J.S. and Duddipati 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.

E-Resources:

1. <https://nptel.ac.in/courses/112105236>
2. <http://nptel.ac.in/courses/112101096/>
3. <https://ocw.mit.edu/courses/mechanical-engineering/2-003j-dynamics-and-vibration-13-013j-fall-2002/download-course-materials/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Acquire the fundamental principles of Kinematic and mechanisms used in machines	2 Understanding 1 Remembering
CLO2	Understand the principles of Analysis for velocity in different mechanisms	1 Remembering 2 Understanding 6 Creating
CLO3	Understand the principles of Analysis for acceleration in different mechanisms	2 Understanding 1 Remembering 6 Creating
CLO4	Select and evaluate the performance of different cams and followers.	3 Applying 4 Analyze
CLO5	Learn the laws of gearing, types of gears, terminologies of spur gears and solve problems of gear and gear train.	2 Understanding 5 Evaluating 6 Creating
CLO6	Understand the principles of Balancing and analyze the different types of vibrations and vibratory systems	5 Evaluating 4 Analyze

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	H	M	L			M	L				L		H	
CLO2		H	M	M	L	L							L	
CLO3		L	M		H			L	M	M			M	
CLO4		H	H	H	H			L	M	M				H
CLO5		H	H	M	L		L			M				M
CLO6								M		M	L	L		M

H: High, M: Medium, L: Low