Kinematics and Dynamics of Machines			
Hours/Week L-T-P :	3-0-0	Credits:	3
Course Type :	Professional Core	Course Code:	MS2101

Prerequisites: Engineering Mechanics, Mechanics of Solid, Engineering Mathematics, Material Science

Course objectives:

1. This course is ideal vehicle for introducing the mechanical engineering students to the process of design. The objectives of the course learning are:
2. The objective of kinematics is to achieve various means of transforming motion to a specific kind needed in various applications.
3. The objective of dynamics is analysis of the behaviour of a given machine or mechanism when subjected to dynamic force.
4. The objectives of Kinematics and dynamics of machines are to use the general concepts which are previously studied with illustrative examples to developing methods and performing analysis of real designs.
5. Hence the KDM involves a great deal of creative details.

Course Outcome:

On successful completion of this course the students should be able to:

CO1: Able to do Basic Kinematic concepts and definitions of Mechanism

CO2: Conversion with Kinematic Analysis and synthesis

CO3: Able to understand the concept of friction in power transmission

CO4: Understanding balancing in machine components

UNIT-1 **9 Hours**

Kinematic fundamental: Introduction to mechanisms and its terminologies - Degree of freedom – Mobility - Kutzbach criterion - Grubler's criterion for planar mechanisms, Grashoff's law, Kinematic Inversions of 4-bar chain - Single slider and double slider crank chains, Quick return mechanism, Limiting positions, Mechanical advantage - Transmission angle and toggle position, Ratchets and escapements, Indexing Mechanisms, Rocking Mechanisms, Straight line generators.

Kinematic Analysis: Graphical analysis of position, velocity and acceleration of simple mechanisms having turning, sliding and rolling pair, Coriolis acceleration using graphical relative motion method, Aronhold-Kennedy Theorem, Instantaneous center method - Four bar and slider crank mechanisms - Analytical method for four bar and slider crank mechanisms.

Mechanism Synthesis: Classification of kinematic synthesis problems - Two position synthesis of slider crank and crank rocker mechanisms, Three position synthesis of double rocker mechanism, Chebychev spacing for precision positions, Freudenstein analytical method.

UNIT-2 9 **Hours**

Cams: Fundamental law of Cam, Cam Terminology, Classification of Cams and followers, Analysis of follower motions (Displacement, velocity, Acceleration and jerk) – Simple Harmonic, Uniform Velocity and Constant Acceleration & Retardation Types, Generation of Cam Profiles by Graphical Method.

Mechanism Trains: Spur gear terminology and definitions, fundamental law of gearing, Theory of shape and action of tooth properties and methods of generation of standard tooth profiles, Standard proportions, Force analysis, Interference and Undercutting, Gear trains, Speed ratio, train value, Parallel axis gear trains, Epicyclic Gear Trains

Friction Effects: Single plate and cone clutches, Anti friction bearing, friction circle, friction axis.

Flexible Mechanical Elements: Belt and chain drives, Initial tension, Effect of centrifugal tension on power transmission, Maximum power transmission capacity, Belt creep and slip.

Brakes: Internal expanding shoe brake.

UNIT-3 **9 Hours**

Mechanism for Control (Governors): Governors - Watt, Porter, Proell, Hartnell. Performance parameters: Sensitiveness, Stability, Hunting, Isochronism. Governor Effort and Power, Controlling Force & Controlling Force Curve, Friction & insensitiveness, Comparison between governor and flywheel.

Mechanism for Control (Gyroscope): Introduction to Gyroscopes. Gyroscopic forces and Couple. Effect of Gyroscopic Couple on Aeroplanes, Gyroscopic stabilization of ship, Stability of Two Wheelers and Four Wheelers. Rigid disc at an angle fixed to rotating shaft.

UNIT-4 **9 Hours**

Balancing of rotating components and linkages: Static and Dynamic Balancing, Balancing of Single Rotating Mass by Balancing Masses in Same plane and in Different planes. Balancing of Several Rotating Masses rotating in same plane and in Different planes. Effect of Inertia Force due to Reciprocating Mass on Engine Frame, Partial balance of single cylinder engines. Balancing of locomotive: variation of tractive force, swaying couple, hammer blow.

Text Books:

1. Kinematics and Dynamics of Machinery by R L Norton, Tata MacGrawHill
2. Theory of Machines and Mechanisms by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
3. Theory of Machines by S.S.Rattan, Tata MacGrawHill
4. Theory of Machines by Thomas Bevan, CBS Publications

Reference Books:

1. Kinematics and Dynamics of Machinery by Charles E. Wilson and J. Peter Saddler, Pearson Education
2. Mechanism and Machine Theory by J.S. Rao and R.V. Dukipatti, New Age International.
3. Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallick, East WestPress.
4. Kinematics and Dynamics of Machines by G.H. Martin, McGraw-Hill.
5. Mechanisms and Dynamics of Machinery by Hamilton H Mabie and Charles F Reinholtz, John- Wiley and Sons.
6. Kinematics, Dynamics, and Design of Machinery by Kenneth J Waldron and Gary L Kinzel, John-Wiley and Sons.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
CO2	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
CO3	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
CO4	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1