



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3131906

Semester III

KINEMATICS AND THEORY OF MACHINES

Type of course: Engineering Science

Prerequisite: Professional Core Course

Rationale: Kinematics and theory of machines is a fundamental course for mechanical engineering. It is intended to introduce essential elements of machines and their functionality. This course is essential for synthesis and kinematics analysis of machine elements like linkages, cams, belt, rope, brakes, clutch and gear.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.
1	Introduction of Mechanisms and Machines: Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom, Mobility and range of movement - Kutzbach and Grubler's criterion, Number Synthesis, Grashof's criterion, straight line mechanisms	8
2	Graphical and Analytical Linkage Synthesis: Synthesis, Function, Path, and Motion Generation, Dimensional synthesis (Graphical): Two position synthesis, Three Position synthesis, Coupler curves, Position Analysis : Graphical position analysis of linkages, Algebraic position analysis of linkages, Four bar slider crank position solution, Two position motion generated by analytical synthesis, Three position motion generated by analytical synthesis.	10
3	Velocity and Acceleration Analysis: Graphical and analytical velocity analysis of fourbar pin jointed linkages and fourbar slider crank linkages, Instant centers of velocity, Graphical and analytical acceleration analysis of fourbar pin jointed linkages and fourbar slider crank linkages, Graphical velocity and acceleration analysis of quick return mechanisms	10
4	Cams: Types of cams, Types of followers, Follower displacement programming, Derivatives of follower Motion, Motions of follower, Layout of cam profiles.	5
5	Belt, Ropes and Chains: Types of belt drive, Velocity ratio, Slip, Pulley arrangement, Length of belt, Law of belting, Ratio of friction tension, Power transmitted, Centrifugal effects on belts, Maximum power transmitted, Creep, Chains, Chain length, Angular speed ratio, Classification of chain	5
6	Friction, Clutch and Brake: Introduction to friction, Law of friction, Coefficient of friction, Inclined plane, Pivot and Collars, Friction clutches, Rolling Friction, Types of brakes, Block and Shoe brakes, Differential band brake, Internal expanding shoe brake, Braking effect in vehicle.	6
7	Gears and Gear Trains: Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, centre distance variation, minimum number of teeth, contact ratio, spur,	8



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helical, spiral bevel and worm gears, problems. Gear Trains: Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.	
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Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	15
Comprehension	15
Application	15
Analysis	25
Evaluate	25
Create	05

References:

1. Theory of Machines, Rattan S S, Tata McGraw-Hill
2. Theory of Machines and Mechanisms, Uicker J J Jr., Pennock G R, Shigley J E, Oxford Press.
3. Kinematics and Dynamics of Machinery, Norton R L, McGraw-Hill
4. Mechanism and Machine Theory, Ambekar, A G, Prentice Hall
5. Theory of Machines, Singh Sadhu, Pearson Education

Course Outcomes:

After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand basic structure and elements of machines.	20
CO-2	Identify functional characteristics of various machine elements.	20
CO-3	Synthesize various mechanisms based on position, velocity and acceleration requirement.	20
CO-4	Determine position, velocity and acceleration of linkages in mechanism at any instant.	20
CO-5	Understand basics related to friction and its practical application in mechanical engineering.	20

List of Practicals:

1. Drawing work related to inversion of four bar mechanism and slider and crank mechanism.
2. Drawing work related to velocity and acceleration diagram of various mechanisms.
3. Drawing work related to cam profile.
4. Drawing work and computation related to synthesis.
5. Computerised Synthesis.
6. Analysis related to belt, rope, and chain drive.
7. Analysis related to brakes, and clutches.
8. Analysis related to gears and gear train.

List of Major Equipments :

- Drawing hall facility.



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- Models of different mechanisms like four bar mechanism, quick return mechanisms, mechanisms with lower pairs and machine elements like belt, pulley, gear, gear train and cams.

List of open source:

- <https://nptel.ac.in/courses/112104121/>