

GUJARAT TECHNOLOGICAL UNIVERSITY

AUTOMOBILE ENGINEERING (02) /MECHANICAL ENGINEERING (19)

KINEMATICS OF MACHINES

SUBJECT CODE: 2131906

B.E. 3RD SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Kinematics of Machines is a fundamental course of mechanisms and machines. It is intended to introduce essential elements of machines and their functionality and engenders skills for kinematics analysis of machine elements like linkages, cams, and gears, within the general machine design context.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
		PA	ALA		ESE	OEP				
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No	Topic	Lectures	Weightage
1	<p>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</p>	4	10%
2	<p>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 of Motion, 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.</p> <p>Velocity and Acceleration Analysis: Velocity and Acceleration Diagrams, Instantaneous Centre of Velocity, Rubbing Velocity, Velocity and Acceleration Images, Corioli's component of acceleration.</p> <p>Special Mechanisms: Straight line mechanism, Indicator diagrams,</p>	4 6 6	40%

	Hooke's Joint, Steering Mechanisms.	3	
3	Gears and Gear Trains: Gears: Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, centre distance variation, minimum number of teeth, contact ratio, spur, helical, spiral bevel and worm gears, problems. Gear Trains: Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.	5 5	25%
4	Cams and Followers: Introduction: Classification of cams and followers, nomenclature, displacement diagrams of follower motion, kinematic coefficients of follower motion. Synthesis and Analysis: Determine of basic dimensions and synthesis of cam profiles using graphical methods, cams with specified contours.	3 6	25%

References:

1. Theory of Machines and Mechanisms (3/e 2009, 2013 Impression) Uicker J J Jr., Pennock G R, Shigley J E, Oxford Press.
2. Kinematics and Dynamics of Machinery (1/e 2009, 2013 Reprint) Norton R L, McGraw-Hill
3. Mechanism and Machine Theory (2013 Reprint), Ambekar, A G, Prentice Hall
4. Theory of Machines, Singh Sadhu, Pearson Education
5. Theory of Machines, Rattan S S, Tata McGraw-Hill

Web Resources

<http://kmoddl.library.cornell.edu/>

Course Outcomes:

1. Students will be able to identify functional characteristics various machine elements.
2. Students will demonstrate the ability to synthesize and analyse mechanisms.
3. Students will demonstrate ability to design and analyse cams.
4. Students will demonstrate the ability analyse gear trains.

Tutorials and Project Work:

1. Tutorials should be designed to cover contents of the theoretical portion.
2. In addition to tutorials assignments should be given to students for additional practice and demonstrate verities in a given topic.
3. Students should be given projects which may include development of computer codes of analytical methods, computer models and computer aided simulations, and development of functioning prototype of various mechanisms.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.