GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS ENGINEERING (20)
KINEMATICS & DYNAMICS OF MACHINES
SUBJECT CODE: 2142001
B.E. 4th Semester

Type of course: Engineering Science

Prerequisite: NA

Rationale: Kinematics and Dynamics is fundamental course for mechatronics engineers to understand various mechanisms. This course is essential for kinematic and dynamic analysis of any mechanism and machine.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Basics of Mechanisms and Machines: Types of Motion, Links, Kinematic Pair, Types of Joints, Degree of Freedom, Classification of Kinematic Pairs, Kinematic Chain, Linkage, Mechanism and Structure, Inversions of Four-bar and Slider Crank Mechanism, Mobility of Mechanisms, Transmission Angle, Pantograph, Exact and Approximate Straight Line Mechanisms	06	12%
2	Velocity and Acceleration Analysis of Mechanisms Absolute and Relative Motion, Velocity and Acceleration Diagrams for four bar and six bar mechanisms, Velocity by Instantaneous Centre Method, Coriolis Acceleration, Klein Construction	09	18%
3	Belts, Ropes and Chains Belt and Rope Drives, Open and Cross Belt Drives, Velocity Ratio, Slip, Material of Belts, Types of Pulleys, Law of Belting, Length of Belts, Ratio of Friction Tensions, Power Transmitted, Centrifugal Effect on Belts, Maximum Power Transmission by Belt, Initial Tension, Creep, Chains, Chain Length, Angular Speed Ratio	05	9%
4	Gears and Gear Trains Classification of Gears, Gear Terminology, Law of Gearing, Velocity of sliding, Gear Teeth Profile, Path of Contact, Arc of Contact, Contact Ratio, Interference of in Involute Gears, Minimum Number of Teeth, Undercutting,	07	14%

	Gear Forces, Different Types of Gear Trains, Analysis of Epicyclic Gear Train			
5	Cams Types of Cams and Followers, Cam Terminology, Derivatives of Follower Motion, Cam Profile Layout	04	8%	
6	GYROSCOPE: Angular Velocity, Angular acceleration, Gyroscopic Torque, Gyroscopic Effect on Naval Ships, Aero plane, Two wheel and Four wheel Automobile	05	9%	
7	Balancing: Static Balancing and Dynamic balancing of Rotating Masses, Balancing of Several Masses in Different Planes, Balancing of Reciprocating Mass	05	10%	
8	Vibrations: Fundamentals of Vibration, Types of Vibrations, Degree of Freedom, Free Vibration, Damped Vibration, Forced Vibration of Single Degree of Freedom System, Magnification Factor, Vibration Isolation and Transmissibility	10	20%	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
30	40	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. Theory of Machines, Rattan S S, Tata McGraw-Hill
2. Kinematics and Dynamics of Machinery, Norton R L, McGraw-Hill
3. Mechanism and Machine Theory, Ambekar, A G, Prentice Hall
4. Theory of Machines, V P Singh, Dhanpat Rai & Co.
5. Theory of Mechanisms and Machines,Amitabha Ghosh &Mallik A. K., EastWest Press

Course Outcomes:

After studying this subject students will be able to:
1. analyze the velocity and acceleration aspects of the planar mechanisms
2. design mechanisms such as belt drive, gear drive etc. from kinematics point of view
3. design cam profiles based on known inputs and analyze velocity and acceleration
4. understand gyroscopic effects and learn basics of vibrations

List of Practical:
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 balancing of rotating masses.

4. Drawing work related to cam profile.
5. Experiment related to gyroscope.
6. Experiment related to balancing of rotating masses.
7. Experiments related to vibration single degree of freedom system free vibration, damped vibration and forced vibration.

Design based/open ended problem
Student may be given a task to perform certain experiments or simulation base exercise related to course material to judge the knowledge.

Major Equipments:
1. Various mechanisms related to the course material
2. Balancing instruments
3. Gyroscope
4. Vibration measuring instruments
5. Other relevant instruments related to course material

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.