



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3132505

Semester III

Kinematics and Dynamics of Machines

Type of course: Professional Core Course

Prerequisite:

Rationale: Kinematics and dynamics of machine is a fundamental course for production/manufacturing and industrial engineering. It is intended to introduce essential elements of machines and their functionality. This course is essential for kinematics analysis of machine elements like linkages, cams, belt, rope and gear. Fundamentals of vibration, balancing and gyroscope are essential for dynamic analysis of machine.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (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	Velocity and Acceleration Analysis: Graphical and analytical velocity analysis of fourbar pin jointed linkages and four bar slider crank linkages, Instant centers of velocity, Graphical and analytical acceleration analysis of four bar pin jointed linkages and four bar slider crank linkages, Graphical velocity and acceleration analysis of quick return mechanisms	10
3	Cams: Types of cams, Types of followers, Follower displacement programming, Derivatives of follower Motion, Motions of follower, Layout of cam profiles.	5
4	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
5	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, helical, spiral bevel and worm gears, problems. Gear Trains: Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.	8
6	Gyroscope: Angular velocity, Angular acceleration, Gyroscopic torque, Gyroscopic effect on naval ships, aero plane, Stability of an automobile, Stability of two wheel vehicle	4
7	Balancing:	5



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	Static balancing and dynamic balancing of rotating masses, balancing of several masses rotating in different planes, Balancing of reciprocating mass, Static and dynamic balancing of machines.	
8	Vibrations: Fundamentals of vibration, Types of vibrations, Degree of freedom, Free vibration, Damped vibration, Forced vibration, Forced damped vibration of single degree of freedom system, Magnification factor, Vibration isolation and transmissibility, Forcing due to unbalance, Forcing due to support motion.	8

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 will be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand functional characteristics and kinematic analysis of mechanical systems.	20
CO-2	Determine position, velocity and acceleration of linkages in mechanism at any instant.	20
CO-3	Select appropriate motion transmission mechanism for machines.	20
CO-4	Recognize importance of gyroscope and balancing in machines.	20
CO-5	Understand the fundamentals of mechanical vibrations.	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. Analysis related to belt, rope, and chain drive.
5. Analysis related to gears and gear train.
6. Experiments related to gyroscope, static and dynamic balancing.
7. Experiments related to free vibration, damped vibration and forced damped vibration.



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List of Major Equipments :

- Drawing hall facility.
- 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.
- Motorised gyroscope set up.
- Static and dynamic balancing set up.
- Universal vibration set up.

List of open source:

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