GUJARAT TECHNOLOGICAL UNIVERSITY

Analysis and Synthesis of Mechanisms

SUBJECT CODE: 3710811

M.E. 1st SEMESTER

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

Rationale: Kinematic analysis of mechanism is must to understand motion transfer by any mechanism. This course is useful to understand motion generated by planar and spatial mechanisms. This course also helps in prepare mechanisms for desire motion.

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)	
3	0	2	4	70	30	30	20	150

Syllabus Contents:

Sr. No.	Topic	Teaching Hrs	Module Weightage
1	**Basic Concepts**: Definitions and assumptions; planar and spatial mechanisms; kinematic pairs;degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Reviewof graphical and analytical methods of velocity and acceleration analysis of kinematically simplemechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.	06	14%
2	**Curvature Theory**: Fixed and moving centrodes, inflection circle, Euler-Savary equation,Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwellmechanisms.	06	14%
3	**Kinematic Synthesis of planar mechanisms:** accuracy (precision) points, Chebesychev spacing,types of errors, Graphical synthesis for function generation and rigid body guidance with two,three and four accuracy points using pole method, centre and circle point curves, Analyticalsynthesis of four-bar and slider-crank mechanisms.	08	20%
4	**Synthesis of Four bar Mechanisms:** Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition,synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers,three accuracy point synthesis using complex numbers.	08	19%

5	**Coupler Curves :** Equation of coupler curve, Robert-Chebychev theorem, double points andsymmetry.	**06**	**14%**
6	**Kinematic Analysis of Spatial Mechanisms :** Denavit-Hartenberg parameters, matrix method ofanalysis of spatial mechanisms	**08**	**19%**

References:

1. R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.
2. Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition
3. Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons NewYork
4. S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York
5. A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.
6. A.G. Erdman and G.N. Sandor, "Mechanism Design – Analysis and Synthesis", (Vol. 1 and 2), Prentice Hall India, 1988.
7. A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India.
8. J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill, 1995.

List of Experiments:

Computer programming for analysis and synthesis of planar and spatial mechanisms.

Course Outcomes:

At the end of the course:

1. To develop analytical equations describing the relative position, velocity and acceleration of all moving links.
2. To select, configure, and synthesize mechanical components into complete systems.
3. Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.
4. Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
5. Analyze and animate the movement of planar and spherical four-bar linkages.
6. Students will be able to apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.
7. Finally Students will demonstrate ability to think creatively, participate in design challenges, and present logical solutions.

List of Open Source Software:

MechAnalyzer