



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Machine Design

Course / Subject Code : ME01000501

Course / Subject Name: Analysis and synthesis of mechanism

w. e. f. Academic Year:	2024-25
Semester:	1 <sup>st</sup> Semester
Category of the Course:	PEC

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes
01	To develop analytical equations describing the relative position, velocity and acceleration of all moving links.
02	To select, configure, and synthesize mechanical components into complete systems.
03	Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.
04	Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
05	Analyze and animate the movement of planar and spherical four-bar linkages.
06	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.
07	Finally, Students will demonstrate ability to think creatively, participate in design challenges, and present logical solutions.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Basic Concepts:</b> Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.	07	14
2	<b>Curvature Theory:</b> Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.	06	14
3	<b>Kinematic Synthesis of planar mechanisms:</b> accuracy (precision) points, Chebyshev 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, Analytical synthesis of four-bar and slider-crank mechanisms.	09	20
4.	<b>Synthesis of Four bar Mechanisms:</b> 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.	09	19
5.	<b>Coupler Curves :</b> Equation of coupler curve, Robert-Chebyshev theorem, double points and symmetry.	06	14
6.	<b>Kinematic Analysis of Spatial Mechanisms :</b> Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms	08	19
	<b>Total</b>	<b>45</b>	<b>100</b>



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## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	50	20	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per 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.

## References/Suggested Learning Resources:

### (a) Books:

1. R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.
2. Robert L. Norton, "Design of Machinery", Tata McGraw Hill Edition
3. Hamilton H. Mabie, "Mechanisms and Dynamics of Machinery", John Wiley and sons New York
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.

## Suggested Course Practical List:

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

## List of Laboratory/Learning Resources Required:



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