



**TEACHING PLAN: DYNAMICS AND MECHANISM DESIGN M.Tech. 2<sup>nd</sup> SEM.**

<b>SCHOOL OF ENGINEERING AND TECHNOLOGY</b>		<b>ACADEMIC SESSION: 2022-23</b>		<b>FOR STUDENTS' BATCH: 2022-2024</b>	
<b>1</b>	<b>Course code</b>	<b>MMED-202</b>			
<b>2</b>	<b>Course Title</b>	<b>DYNAMICS AND MECHANISM DESIGN.</b>			
<b>3</b>	<b>Credits</b>	<b>4</b>			
<b>4</b>	<b>Learning Hours</b>	<b>Contact Hours</b>			<b>3</b>
		<b>Practical Teaching</b>			<b>0</b>
		<b>Project, Tutorial, and Assessment</b>			<b>1</b>
		<b>Total hours</b>			<b>4</b>
<b>5</b>	<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Understand different methods of velocity analysis of a mechanism.</li> <li>2. To include dynamics considerations in the design of mechanisms for engineering applications.</li> <li>3. Understand various methods for synthesizing a mechanism.</li> <li>4. Formulation of Equations of motion for various systems.</li> <li>5. Understand basic concept of synthesizing a cam.</li> </ol>			
<b>6</b>	<b>Course Outcomes</b>	<p>On completion of the course the student will be able to,</p> <ol style="list-style-type: none"> <li>1. <i>Examine</i> the velocities of different mechanism in engineering field.</li> <li>2. <i>Design</i> different mechanism based on the given variables.</li> <li>3. <i>Compare</i> various position of mechanism for a given variables.</li> <li>4. <i>Design</i> a cam profile for the given data.</li> <li>5. <i>Examine</i> the various parameters of a spatial mechanism.</li> </ol>			
<b>7</b>	Outline syllabus: Geometry of Motion, Generalized Principles of Dynamics, Synthesis of Linkages, Graphical Methods of Dimensional Synthesis, Analytical Methods of Dimensional Synthesis, Analysis of Cams.				
<b>7.01</b>	<b>Paper Code</b>	<b>Unit</b>	<b>Introduction</b>	<b>Reference number</b>	<b>Teaching methods</b>
	<b>MMED-202</b>	<b>I</b>	<b>Geometry of Motion:</b> Introduction, analysis and synthesis, Mechanism terminology, planar, Spherical and spatial mechanisms, mobility, Grashoff's law, Equivalent mechanisms, Unique mechanisms, Kinematic analysis of plane mechanisms: Auxiliary point method using rotated velocity vector, Hall - Ault auxiliary point method, Goodman's indirect method.	J. E. Shigley, Theory of Machines and Mechanism, McGraw-Hill.	White Board, PPT
		<b>II</b>	<b>Generalized Principles of Dynamics:</b> Fundamental laws of motion, Generalized coordinates, Configuration space, Constraints, Virtual work, principle of virtual work, Energy and momentum, Work and kinetic energy, Equilibrium and stability, Kinetic energy of a system, Angular momentum, generalized momentum. Lagrange's Equation: Lagrange's equation from	J. E. Shigley, Theory of Machines and Mechanism, McGraw-Hill.	White Board, PPT

		D'Alembert's principles, Examples Hamilton's equations, Hamilton's principle, Lagrange's, equation from Hamilton's principle, Derivation of Hamilton's equations, Examples.		
	III	<b>Synthesis of Linkages:</b> Type, number, and dimensional synthesis, Function generation, Path generation and Body guidance, Precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanisms, Crank-rocker mechanisms with optimum transmission angle Motion Generation: Poles and relative poles, Location of poles and relative poles, polode, Curvature, Inflection circle.	J. E. Shigley, Theory of Machines and Mechanism, McGraw-Hill.	White Board, PPT
	IV	<b>Graphical Methods of Dimensional Synthesis:</b> Two position synthesis of crank and rocker mechanisms, Three position synthesis, Four position synthesis (point precision reduction) Overlay method, Coupler curve synthesis, Cognate linkages. <b>Analytical Methods of Dimensional Synthesis:</b> Freudenstein's equation for four bar mechanism and slider crank mechanism, Examples, Bloch's method of synthesis, Analytical synthesis using complex algebra.	J. E. Shigley, Theory of Machines and Mechanism, McGraw-Hill.	White Board, PPT
	V	<b>Analysis of Cams:</b> Basic curves, pressure, angle-Cam size determination, Cam profile determination- Analytical and graphical. Advanced curves-combination of curves, Polydyne cams. Cam dynamics: Cam force analysis-Dynamics of high speed cam system, source of vibration, Follower response-Phase plane method, Johnson's Numerical Analysis, Position error-Jump and cross-over shock, Spring surge and wind up. <b>Spatial Mechanisms:</b> Introduction, Position analysis problem, Velocity and acceleration analysis, Eulerian angles.	J. E. Shigley, Theory of Machines and Mechanism, McGraw-Hill.	White Board, PPT
8	<b>Course Evaluation</b>			
8.10	<b>CA: 20%</b>			
8.1	<b>Attendance</b>	10%		
8.12	<b>Homework</b>	10%		

8.13	Quizzes	-
8.14	Projects	-
8.15	Presentation	-
8.16	Any other	-
8.2	MTE(IA)	20%
8.3	<b>End-term examination: 60%</b>	
9	<b>Text Books &amp; References</b>	
9.1	Text books	<ol style="list-style-type: none"> <li>1. K. J. Waldron &amp; G. L. Kinzel , Kinematics, Dynamics and Design of Machinery, Wiley India, 2007</li> <li>2. D. T. Greenwood, “Classical Dynamics”, Prentice Hall of India, 1988.</li> </ol>
9.2	References	<ol style="list-style-type: none"> <li>1. J. E. Shigley, Theory of Machines and Mechanism, McGraw-Hill, 1995.</li> <li>2. A. G. Ambekar, Mechanism and Machine Theory, PHI, 2007.</li> <li>3. Ghosh and Mallick, Theory of Mechanism and Mechanism, East West press, 2007.</li> <li>4. D. H. Myszka, Machines and Mechanisms, Pearson Education, 2005.</li> <li>5. A. R. Holowenko, Dynamics of Machinery, Wiley, 2007.</li> <li>6. A. S. Hall, Kinematics and Linkage Design, Prentice Hall, 2007.</li> </ol>
9.3	Video References	<a href="http://www.digimat.in/nptel/courses/video/112104114/L02.html">http://www.digimat.in/nptel/courses/video/112104114/L02.html</a> <a href="https://www.digimat.in/nptel/courses/video/112105268/L01.html">https://www.digimat.in/nptel/courses/video/112105268/L01.html</a> <a href="https://www.digimat.in/nptel/courses/video/112104298/L24.html">https://www.digimat.in/nptel/courses/video/112104298/L24.html</a>

#### Mapping of Outcomes v. Topics

Course Outcome	Program Outcome												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	3	3	2	1	3	2	2	3	3	3	3	2
CO2	3	3	3	3	3	3	2	1	2	2	2	3	3	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	1	2	2	2	3	3	3	3	2
CO5	3	3	3	3	3	3	3	1	2	3	2	3	3	3	3	2

#### QUESTION BANK

1. What are mechanisms in design?
2. What is the goal of mechanism design?
3. What are the five basic mechanisms?
4. What is called mechanism?
5. What is the main function of mechanism?
6. What is the role of mechanism?
7. What are the elements of mechanism?

8. What are the 6 mechanical systems?
9. How do you create a mechanism?
10. Explain one inversion of each of the following mechanism with neat sketches.
11. Quadratic chain ii) Single slider crank chain iii) Double slider crank chain.
12. State and explain Grashoff's law.
13. Explain holonomic and Non-holonomic constraints.
14. Explain the principle of virtual work.
15. Derive the expression for Lagrangian for holonomic system.
16. Deduce the condition for free precession of gyroscope with steady precession.
17. Synthesize a function generator to generate a function  $y = \log_e x$  in the range  $1 \sim x \sim 10$ .  
Use three accuracy points and Freudenstein's equation. Take length of smallest link 50mm.  
Make the sketch of the linkage.
18. The rocker of crank rocker mechanism is to have length of 50mm and swings through a total angle of  $45^\circ$  with a time ratio of 1.25. Determine the suitable set of dimensions.
19. Explain Caley's diagram for cognates.
20. Briefly explain "Over lay method" of synthesis.
21. Write short notes on any five of the following: a) Path Generation b) Types of synthesis c) Bloch synthesis d) Four position synthesis (point position reduction) e) Inflection circle f) Position Analysis and RGR mechanism g) Velocity Analysis by Auxiliary point method.
22. What is a graphical synthesis?
23. What is dimensional synthesis?
24. What do you mean by synthesis of mechanism?
25. What are the types of graphical method?
26. What are the 3 required elements of dimensional analysis?
27. What are the types of dimensional analysis?
28. What are the 3 applications of dimensional analysis?
29. What are the two methods of synthesis?
30. What are the three types of synthesis?
31. What are the 4 steps of synthesis?
32. What is kinematic analysis of mechanism?
33. What are the two types of kinematic analysis?
34. What is the purpose of kinematic analysis?
35. What are the types of mechanism in kinematics?
36. What are the three types of kinematics?
37. What are different types of kinematics?
38. What is the difference between kinematic and kinetic analysis?
39. What is the difference between kinematic and dynamic analysis?
40. What is mechanism in kinematics of machine?
41. What are the 5 kinematic symbols?