ANNA UNIVERSITY, CHENNAI

NON- AUTONOMOUS COLLEGES

AFFILIATED TO ANNA UNIVERSITY

M.E. ENGINEERING DESIGN

REGULATIONS 2025

PROGRAMME OUTCOMES (POs):

After studying Engineering Design, our students will exhibit ability to:

PO	Programme Outcomes
PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO	Programme Specific Outcomes
PSO1	Apply advanced principles of mechanics, materials, and computational methods to design, analyze, and optimize mechanical systems and components using modern tools and simulation techniques.
PSO2	Develop innovative and sustainable engineering solutions through integrated product design, lifecycle management, and advanced manufacturing processes.

ANNA UNIVERSITY, CHENNAI

POST GRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: M.E., Engineering Design **Regulations:** 2025

Abbreviations:

BS –Basic Science (Mathematics)

ES – Engineering Science (General (**G**), Programme Core (**PC**), Programme Elective (**PE**))

SD – Skill Development

OE – Open Elective

L –LaboratoryCourse

T – Theory

LIT –Laboratory Integrated Theory

PW – Project Work

TCP –Total Contact Period(s)

Semester I

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.	MA25C06	Applied Mathematical and Statistical Modelling	LIT	3	1	0	4	4	BS
2.	ED25C01	Topology Optimization and Generative Design	T	3	0	0	3	3	ES (PC)
3.	ED25C02	Advanced Mechanics of Materials	T	3	0	0	3	3	ES (PC)
4.	ED25C03	Design and Analysis of Advanced Mechanisms	LIT	3	0	2	5	4	ES (PC)
5.	ED25C04	Design Practice with CAD Tools Laboratory	L	0	0	4	4	2	ES (PC)
6.	ED25C05	Multi Body Dynamics Laboratory	L	0	0	4	4	2	ES (PC)
7.	ED25101	Technical Seminar	-	0	0	2	2	1	SD
Total Credits							**25**	**19**	

Semester II

S. No.	Course Code	Course Title	Type	Periods per week L	T	P	TCP	Credits	Category
1.		Finite Element Methods	LIT	2	0	4	6	4	ES (PC)
2.		Vibration, Fracture, and Failure Analysis	T	4	0	0	4	4	ES (PC)
3.		Computational Fluid Dynamics	LIT	2	0	2	4	3	ES (PC)
4.		Programme Elective – I	T	3	0	0	3	3	ES (PE)
5.		Programme Elective – II	T	3	0	0	3	3	ES (PE)
6.		Programme Elective – III	T	3	0	0	3	3	ES (PE)
7.		Industry Oriented Course I	-	1	0	0	1	1	SD
8.		Research Article Replication Practice	L	0	0	2	2	1	ES (PC)
9.		Self-Learning Course	-	-	-	-	-	1	-
Total Credits							**27**	**23**	

Semester III

S. No.	Course Code	Course Title	Type	Periods per week L	T	P	TCP	Credits	Category
1.		Programme Elective - IV	T	3	0	0	3	3	ES (PE)
2.		Programme Elective - V	T	3	0	0	3	3	ES (PE)
3.		Programme Elective - VI	T	3	0	0	3	3	ES (PE)
4.		Open Elective	T	3	0	0	3	3	-
5.		Industry Oriented Course II	-	1	0	0	1	1	SD
6.		Project Work I	-	0	0	12	12	6	SD
Total Credits							**25**	**19**	

SemesterIV

S. No.	Course Code	Course Title	Type	Periods per week L	T	P	TCP	Credits	Category
1.		Project Work II	-	0	0	24	24	12	SD
Total Credits							**24**	**12**	

PROGRAMME ELECTIVE COURSES (PE)

S. No.	Course Code	Course Title	Periods			Total Contact Periods	Credits
			L	T	P		
1.		Design with Advanced Materials	3	0	0	3	3
2.		Integrated Product Design and Development	3	0	0	3	3
3.		Design for Sustainability	3	0	0	3	3
4.		Composite Materials and Mechanics	3	0	0	3	3
5.		Quality Concepts in Design	3	0	0	3	3
6.		Bearing Design and Rotor Dynamics	3	0	0	3	3
7.		Solid Freeform Manufacturing	3	0	0	3	3
8.		Product Lifecycle Management	3	0	0	3	3
9.		Design of Hydraulic and Pneumatic Systems	3	0	0	3	3
10.		Mechanical Measurements and Analysis	3	0	0	3	3
11.		Surface Engineering	3	0	0	3	3
12.		Computer Graphics	3	0	0	3	3
13.		Vehicle Dynamics	3	0	0	3	3
14.		Advanced Finite Element Analysis	3	0	0	3	3
15.		Advanced Machine Tool Design	3	0	0	3	3
16.		Material Handling Systems and Design	3	0	0	3	3
17.		Creativity and Innovation Management	3	0	0	3	3

Semester I

MA25C06	Applied Mathematical and Statistical Modelling	L	T	P	C
		3	1	0	4

Course Objectives:

- To equip students with advanced mathematical techniques, specifically Fourier Transforms, for formulating and solving partial differential equations that model fundamental mechanical engineering phenomena such as heat transfer, vibrations, and fluid flow.
- To provide a strong foundation in statistical inference, enabling students to estimate population parameters (like material properties and process capabilities) from experimental data and assess the quality and reliability of these estimators.
- To enable students to design efficient, structured experiments and apply appropriate statistical tests to make valid, data-driven decisions for comparing processes, optimizing designs, and solving complex engineering problems.

Fourier Transform: Definitions, Properties, Transform of elementary functions, Dirac delta function, Convolution theorem, Parseval's identity, Solutions to partial differential equations: Heat equation, Wave equation, Laplace and Poison's equations.

Estimation Theory: Unbiasedness, Consistency, Efficiency and sufficiency, Maximum likelihood estimation, Method of moments.

Testing of Hypothesis: Sampling distributions, Small and large samples, Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions, Analysis of r x c tables, Goodness of fit, independent of attributes.

Design of Experiments: Analysis of variance, One way and two-way classifications, Completely randomized design, Randomized block design, Latin square design, 2^2 Factorial design.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

References:

1. Andrews, L. C., & Shivamoggi, B. K. (2003). Integral transforms for engineers. Prentice Hall of India.
2. Devore, J. L. (2014). Probability and statistics for engineering and the sciences, Cengage Learning.
3. Johnson, R. A., Miller, I., & Freund, J. (2015). Miller and Freund's probability and statistics for engineers, Pearson Education Asia.

E-resources:

1. https://www.edx.org/learn/probability-and-statistics/massachusetts-institute-of-technology-probability-the-science-of-uncertainty-and-data
2. https://www.itl.nist.gov/div898/handbook/
3. https://ocw.mit.edu/courses/2-830j-control-of-manufacturing-processes-sma-6303-spring-2008

ED25C01	Topology Optimization and Generative Design	L	T	P	C
		3	0	0	3

Course Objective:

This course aims to provide students with a comprehensive understanding of optimization techniques applied to mechanical engineering design, with a focus on topology optimization and generative design. It introduces mathematical formulations and programming methods such as linear, nonlinear, and integer optimization, along with sensitivity and gradient-based approaches. Students will explore topology optimization techniques including SIMP and level set methods for efficient material distribution, and learn generative design principles using rule-based and AI-driven systems integrated with additive manufacturing. The course also addresses advanced topics such as multi-objective optimization, robust and reliability-based design, and sustainability considerations. By the end of the course, students will be equipped to apply computational and algorithmic methods to develop optimized, innovative, and practical engineering solutions.

Fundamentals of Optimization in Mechanical Engineering: Introduction to Optimization Techniques, Importance of Optimization in Mechanical Design, Applications of Topology Optimization and Generative Design in Mechanical Systems. Mathematical Formulation of Optimization Problems, Mathematical Programming Methods: Linear, Nonlinear, and Integer Programming Sensitivity Analysis and Gradient-Based Methods

Activities: Manual Formulation of Optimization Problems: Students will identify a simple mechanical design problem (e.g., truss structure) and manually define its objective function, design variables, and constraints. This helps in understanding mathematical modeling of real-world problems.

Python Implementation of Gradient-Based Optimization:Implement a basic gradient-based method (like steepest descent) to minimize a simple function (e.g., weight minimization of a cantilever beam). Students analyze convergence behavior and parameter effects.

Principles of Topology Optimization: Introduction to Topology Optimization, Problem Formulation and Design Domain, Material Distribution Methods (SIMP, Level Set), Optimization Algorithms for Topology Optimization, Case Studies and Applications in Mechanical Components

Activities: Topology Optimization Using 2D SIMP Method: Use open-source tools or coding to perform 2D topology optimization of a bracket. Students modify boundary conditions and volume fraction to observe material distribution changes.

Generative Design and Computational Techniques: Overview of Generative Design Principles, Evolutionary Algorithms for Design Generation, Rule-Based and AI-Based Generative Systems, Integration with Additive Manufacturing, Generative Design Tools and Case Studies

Activities: Generative Design with CAD Software: Perform a generative design study using CAD Sofware for a component (e.g., bike stem or connecting rod). Analyze various generated design options based on load paths and constraints.

Advanced Concepts and Future Trends: Multi-Objective Optimization and Trade-Off Strategies, Optimization Under Uncertainty, Robust and Reliability-Based Design, Sustainability in Design Optimization, Future Challenges and Research Trends in Topology Optimization and Generative Design

Activities: Multi-Objective Trade-off Analysis using Pareto Fronts: Use Python or Excel to generate Pareto fronts for two conflicting objectives (e.g., stiffness vs. weight). Students interpret the trade-off and identify optimal design decisions.

Case Study Presentation on Sustainable Generative Design: In groups, students research and present a real-world case (e.g., Airbus bracket or Nike Flyprint shoe) that uses generative design for sustainability. Focus on how design choices reduce material use or carbon footprint.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. Belegundu, A. D., and Chandrupatla, T. R., Optimization Concepts and Applications in Engineering, Cambridge University Press, 2011.
2. Chong, E. K. P., and Zak, S. H., Introduction to Optimization, Wiley, 2013.
3. Boyd, S., and Vandenberghe, L., Convex Optimization, Cambridge University Press, 2004.
4. Bohnacker, H., Gross, B., Laub, J., and Lazzeroni, C., Generative Design: Visualize, Program, and Create with Processing, Princeton Architectural Press, 2012.
5. Adeli, H., Advanced Structural Optimization, Chapman & Hall/CRC, 1994.

COURSE OUTCOME (CO)	PO	PSO1	PSO2
CO1: Apply optimization techniques (linear, nonlinear, integer programming) to solve mechanical design problems, focusing on material distribution and design efficiency.	PO1 (3), PO3 (2)	3	2
CO2: Implement gradient-based optimization methods for practical problems, such as minimizing weight in mechanical systems, and analyze convergence behavior.	PO1 (3), PO2 (2)	3	2
CO3: Perform topology optimization using SIMP and level set methods for efficient material distribution in mechanical components, and evaluate the optimization results.	PO1 (3), PO3 (3)	3	3
CO4: Use generative design principles, evolutionary algorithms, and AI-driven systems for design generation, with a focus on integrating with additive manufacturing.	PO2 (3), PO3 (3)	3	3

ED25C02	Advanced Mechanics of Materials	L	T	P	C
		3	0	0	3

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the theory of elasticity and advanced stress analysis techniques essential for the design and evaluation of mechanical and structural components. The course emphasizes the formulation and solution of stress-strain relations, equilibrium equations, and compatibility conditions in various coordinate systems. It covers the analysis of flat plates, curved beams, torsional members, and rotating bodies, along with the evaluation of contact stresses and deflections. Students will develop the ability to apply analytical and energy methods to solve complex solid mechanics problems encountered in real-world engineering applications.

Elasticity: Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, theories of failure, differential equations of equilibrium, compatibility, boundary conditions-representation of three-dimensional stress of a tension generalized hook's law, St. Venant's principle, plane stress, Airy's stress function. Energy methods

Activities: Use MATLAB/ANSYS to visualize 3D stress states and Airy’s stress function solutions, Apply failure theories to real-life engineering components (e.g., pressure vessel, shaft).

Stresses In Flat Plates and Curved Members: Circumference and radial stresses, deflections, curved beam with restrained ends, closed ring subjected to concentrated load and uniform load, chain links and crane hooks. Solution of rectangular plates, pure bending of plates, deflection, uniformly distributed load, various end conditions.

Activities: Analyze deflection of a rectangular plate under UDL using ANSYS, Compare analytical vs FEM solutions for curved beams, Write a technical note on applications of plate theory in aerospace or civil structures.

Shear and Torsion: Location of shear centre for various thin sections, shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section, General Torsional equation, Torsion of rectangular cross section, St.Venants theory, elastic membrane analogy, Prandtl’s stress function, torsional stress in hollow thin walled tubes and multi-walled sections

Activities: Find the shear center for an open thin-walled section experimentally (e.g., channel section), Use FEM to analyze torsional stresses in rectangular and hollow thin-walled tubes, Students design a beam subjected to unsymmetrical bending and justify choice of section.

Stresses in Rotating Members and Contact Stresses: Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications

Activities: Calculate allowable speeds for rotating discs (e.g., turbine blade roots, flywheels), Use ANSYS/ABAQUS to simulate stress in rotating discs with varying thickness, Mini project on predicting failure in machine components under contact stresses.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. Boresi, A. P., & Schmidt, R. J. (2009). *Advanced mechanics of materials*. Wiley India Pvt. Ltd.
2. Hibbeler, R. C. (2011). *Mechanics of materials*. Prentice Hall.
3. Cook, R. D., & Young, W. C. (1999). *Advanced mechanics of materials*. Prentice Hall.
4. Chandramouli, P. N. (2017). *Theory of elasticity*. Yes Dee Publishing.
5. Srinath, L. S. (2010). *Advanced mechanics of solids*. Tata McGraw-Hill.
6. Timoshenko, S., & Goodier, J. N. (2010). *Theory of elasticity*. Tata McGraw-Hill.

	Description of CO	**PO**	**PSO1**	**PSO2**
CO1	Understand and apply fundamental concepts of elasticity, stress-strain relations, and equilibrium equations to analyze mechanical components under various loading conditions.	PO3 (3)	1	3
CO2	Analyze stresses and deflections in flat plates, curved beams, and torsional members using analytical and energy methods.	PO3 (3)	2	3
CO3	Evaluate stresses in rotating members and contact stresses in mechanical components for design and failure analysis.	PO1 (3), PO3 (2)	3	2
CO4	Develop problem-solving skills to formulate and solve complex solid mechanics problems encountered in real-world engineering applications.	PO1 (3), PO2 (2)	2	3

ED25C03	Design and Analysis of Advanced Mechanisms	L	T	P	C
		3	0	2	4

Course Objective:

The main learning objective of this course is to prepare the students for acquiring the knowledge on various mechanisms and its design and simulation.

Introduction: Review of fundamentals of kinematics, classifications of mechanisms, components of mechanisms, mobility analysis, formation of one D.O.F. multi loop kinematic chains, Network formula, Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators, Compliant mechanismsEquivalent mechanisms.

Activities: Create Mobility Calculations for Various Mechanisms, Build and Classify Real-life Mechanisms Using LEGO/Modeling Kits,Identify and Compare Serial vs Parallel Robot Structures,Simulation of Basic Compliant Mechanism in a CAD Tool

Kinematic Analysis: Position Analysis, Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis, four bar linkage jerk analysis. Plane complex mechanisms, auxiliary point method. Spatial RSSR mechanism,DenavitHartenberg Parameters, Forward and inverse kinematics of robot manipulators.

Activities: Vector Loop Equation Modeling in software,Acceleration and Jerk Analysis for Four-bar Linkage, Forward & Inverse Kinematics of a Robot Arm (2 or 3 DOF), Create a Physical Model of a Complex Mechanism

Path Curvature Theory, Coupler Curve: Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions, cubic of stationary curvature. Four bar coupler curve-cusp, crunode, coupler driven sixbarmechanisms,straight line mechanisms.

Activities: Graphical Construction of Inflection Circle and Centrodes,Simulation of a Four-Bar Coupler Curve Using software,Demonstration of Cusp and Crunode with Coupler Curve,Build a Straight Line Mechanism (e.g., Peaucellier or Scott-Russell)

Synthesis of Four Bar Mechanisms: Type synthesis, Number synthesis, Associated Linkage Concept. Dimensional synthesis, function generation, path generation, motion generation. Graphical methods-Pole technique inversion techniquepoint position reduction-two, three and four position synthesis of four-bar mechanisms. Analytical methods- Freudenstein’s Equation-Bloch’s Synthesis.

Activities: Graphical Synthesis Using Three-Position Path Generation,Use software to Solve Freudenstein’s Equation, Pole and Inversion Technique Exercise Using CAD
Case Study: Mechanism Design for a Real-world Application

Synthesis of Coupler Curve Based Mechanisms: Cognate Linkages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwelldouble stroke. Geared five bar mechanism-multi-dwell.

Activities : Design and Simulate Cognate Mechanisms for Identical Coupler Curves,Build a Working Model of a Dwell Mechanism,Synthesize a Geared Five-Bar Mechanism in Software,Study and Presentation: Application of Multi-Dwell in Packaging Industry
CAM Mechanisms: CAM Mechanisms- determination of optimum size of CAMs. Mechanism defects. **Activities:**Design a CAM Profile Using CAM Design Software, Simulation of CAM Follower System for Different Motions, Case Study: Identify Defects in Existing CAM Mechanism Designs, 3D Print a Custom CAM Profile and Test Mechanism Motion
Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%
Assessment Methodology: Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)
References: 1. Ghosh, A., & Mallik, A. K. (1999). Theory of mechanism and machines. EWLP. 2. Waldron, K. J., & Kinzel, G. L. (2016). Kinematics, dynamics and design of machinery. John Wiley & Sons. 3. Norton, R. L. (2012). Design of machinery. Tata McGraw-Hill. 4. Sandor, G. N., & Erdman, A. G. (1984). Advanced mechanism design: Analysis and synthesis. Prentice Hall. 5. Uicker, J. J., Pennock, G. R., & Shigley, J. E. (2017). Theory of machines and mechanisms. Oxford University Press.

Course Outcome (CO)	PO	PSO1	PSO2
CO1: Apply kinematic analysis methods to design and simulate the motion of basic mechanisms (e.g., four-bar, slider-crank).	PO1 (3), PO2 (2)	3	2
CO2: Synthesize and design complex mechanisms, such as four-bar and six-bar linkages, to meet specific motion generation or path generation objectives.	PO1 (3), PO3 (3)	3	3
CO3: Analyze and synthesize compliant mechanisms and path curvature theory to optimize motion and performance of mechanical systems.	PO1 (3), PO3 (2)	3	2
CO4: Design and simulate CAM mechanisms, including optimizing cam profiles and testing different motion types using simulation software.	PO1 (3), PO2 (3)	3	3

ED25C04	Design Practice with CAD Tools Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

The objective of this course is to equip students with the fundamental and practical knowledge of engineering drawing standards and CAD tools, enabling them to interpret and create accurate 2D and 3D representations of mechanical components and assemblies. The course aims to develop skills in applying BIS conventions, tolerancing, and geometric dimensioning, constructing orthographic projections, producing part and assembly drawings, and simulating basic kinematic mechanisms using CAD software for real-world mechanical applications.

Study exercise

1. Code of practice for Engineering Drawing, BIS/ASME specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.
2. Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerancing.
3. Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

Sketching for solid modeling

4. Orthographic projection of mechanical parts: Hexagonal Nut, Sectioned Hollow stepped shaft, L – Bracket, Slotted Blocks, other similar parts.

Part Drawing, Assembly and Geometrical Properties

5. Bearings – Bush Bearing, Taper bearing
6. Valves – Safety and Non-return Valves.
7. Couplings – Flange, Oldham's, Muff, Gear couplings.
8. Joints – Universal, Knuckle, Gib & Cotter, Strap, Sleeve & Cotter joints.
9. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, Multi-plate clutch.
10. Machine Components – Screw Jack, Machine Vice, Lathe Tail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.

Kinematics

11. Simulation of slider crank mechanism
12. Simulation of crank and rocker mechanism

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

	Description of CO	PO	PSO1	PSO2
CO1	Apply engineering drawing standards, BIS/ASME specifications, and tolerancing principles for mechanical components.	PO1 (3), PO3 (2)	2	2
CO2	Create accurate 2D orthographic projections and detailed part drawings of mechanical components using CAD tools.	PO1 (3), PO3 (3)	3	2
CO3	Develop assembly drawings and interpret geometric properties of machine components and joints.	PO1 (2), PO3 (3)	3	2
CO4	Simulate basic kinematic mechanisms (slider crank, crank and rocker) using CAD software for mechanical applications.	PO1 (3), PO3 (3)	3	2

ED25C05	Multi Body Dynamics Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

The main learning objective of this course is to prepare the students for understanding the forces and torques that come into action in various kinds of mechanical systems.

List of Experiments:

1. Free fall of rigid body
2. Projectile motion
3. Simulation of simple Pendulum
4. Simulation of Compound Pendulum
5. Kinematic Analysis four bar and slider crack mechanism and its inversions
6. Dynamic Analysis four bar and slider crack mechanism and its inversions
7. Design of CAM Profile for various follower output motion
8. Kinematic & Dynamic Analysis of Gear Tracks
9. Vibration Analysis SDOF and MDOF
10. Project on virtual product design using Commercial Software Package

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

Course Outcome (CO)	PO	PSO1	PSO2
CO1: Analyze and simulate free fall, projectile motion, and pendulum dynamics to understand basic motion and forces in mechanical systems.	PO1 (3), PO3 (2)	3	2
CO2: Perform kinematic and dynamic analysis of four-bar and slider-crank mechanisms, including their inversions, to understand mechanical system behavior.	PO1 (3), PO2 (2)	3	2
CO3: Design and simulate CAM profiles for various follower output motions to understand motion generation in mechanical systems.	PO1 (3), PO3 (2)	3	3
CO4: Conduct vibration analysis (SDOF and MDOF) and evaluate the dynamic behavior of mechanical systems under different excitation conditions.	PO1 (3), PO2 (3)	3	2
CO5: Design a virtual product using commercial software, integrating multi-body dynamics principles in product design and analysis.	PO2 (3), PO3 (3)	3	3