ANNEXURE I

MODULE-WISE COURSE CONTENT AND OUTCOME				
SL. NO	**MODULE NAME**	**MODULE CONTENT**	**MODULE LEARNING OUTCOME**	**DURATION (HRS)**
1	Introduction to Tool Design and Autodesk Inventor	● Overview of tool design: Jigs, fixtures, and cutting tools. ● Basics of the Autodesk Inventor interface and navigation. ● 2D sketching tools and geometry creation. ● Overview of constraints and dimensions.	● Understand the basics of tool design and its applications in manufacturing. ● Navigate Autodesk Inventor confidently. ● Create 2D sketches and apply basic constraints. ● Recognize the importance of accurate geometry in tool design..	5
2	Parametric Modeling for Tool Design	● Introduction to parametric modeling concepts. ● Creating and editing sketches with constraints. ● Using features: Extrude, Revolve, Sweep, and Loft. ● Building advanced 3D models for tool components.	● Grasp the fundamentals of parametric modeling. ● Develop complex 3D models using advanced features. ● Apply constraints effectively for accurate modeling. ● Design tool components with precision and functionality.	8
3	Assembly Design and Constraints	● Assembling tool components in Autodesk Inventor. ● Applying and troubleshooting assembly constraints. ● Using joints and motion relationships in assemblies. ● Analyzing the fit and motion of	● Assemble multiple components to form a functional tool. ● Apply constraints and motion relationships for accurate assemblies. ● Simulate the movement of tools within an	7

		assembled tools.	assembly. ● Identify and resolve issues in tool assembly design.	
4	Stress and Motion Analysis	● Basics of Finite Element Analysis (FEA). ● Applying materials, loads, and boundary conditions. ● Conducting stress and deformation analysis. ● Simulating tool motion and analyzing results.	● Understand the principles of FEA in tool design. ● Perform stress and deformation analysis for tool components. ● Simulate and analyze motion to validate design functionality. ● Optimize tool designs for strength and performance.	5
5	Design for Manufacturing and Assembly (DFMA)	● DFMA principles and their importance. ● Designing for manufacturability and assembly ease. ● Material selection based on functionality and cost. ● Reducing errors through optimized design strategies.	● Apply DFMA principles to enhance tool design efficiency. ● Design tools that are easy and cost-effective to manufacture. ● Select materials suited for specific tool applications. ● Minimize errors and simplify assembly processes.	3
6	Technical Documentation and Drawings	● Generating 2D drawings from 3D models. ● Applying dimensions, annotations, and GD&T symbols. ● Creating exploded views for assembly instructions. ● Generating a Bill	● Create professional-quality technical drawings. ● Apply dimensions and annotations to convey design intent. ● Use GD&T symbols accurately in	6

		of Materials (BOM). ● Exporting files in industry-standard formats.	drawings. ● Generate detailed BOMs for manufacturing and assembly. ● Export designs for production and collaboration.	
7	Real-World Project and Case Studies	● Assigning a comprehensive tool design project. ● Researching and brainstorming design solutions. ● Applying course concepts to create a complete tool design. ● Reviewing case studies of industrial tool designs. ● Testing and validating the final design. ● Preparing a project report and presentation. ● Receiving feedback and refining the design.	● Develop a complete tool design using Autodesk Inventor. ● Apply research and innovation to solve design challenges. ● Analyze case studies to draw insights for practical applications. ● Validate and test tool designs for real-world functionality. ● Create a comprehensive project report and present findings. ● Work collaboratively in a team environment. ● Refine designs based on feedback and analysis.	11

ANNEXURE II

OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USECASES			
LEARNING OUTCOME	**ASSESSMENT CRITERIA**	**PERFORMANCE CRITERIA**	**USECASES**
Understand the fundamentals of tool design, DFMA principles, and Autodesk Inventor features.	● Quizzes on tool design concepts, DFMA principles, and Autodesk Inventor features. ● Short written assessments to explain theoretical concepts.	● Achieve at least 70% on quizzes covering key concepts. ● Demonstrate clear understanding of DFMA and Autodesk Inventor in written assessments, with correct explanations and examples.	● Manufacturing Industry: Understanding of design principles helps in creating cost-effective and easily manufacturable tools. ● Product Design Teams: Ensures efficient use of Autodesk Inventor in early design phases.
Create accurate parametric 3D models and assemblies of industrial tools using Autodesk Inventor.	● Assignments for creating parametric 3D models (using features like extrude, revolve, sweep). ● Hands-on exercises to assemble and constrain multiple components in Autodesk Inventor.	● Complete 3D models and assemblies with 100% accuracy in geometry, constraints, and functionality. ● Submit assignments free of modeling errors and incorrect assembly constraints.	● Automotive Industry: Designing custom tooling for vehicle parts with precision. ● Tooling Companies: Creating jigs, fixtures, and cutting tools for different manufacturing processes.
Perform stress and motion analyses to validate and optimize tool designs.	● Finite Element Analysis (FEA) assignments to perform stress and deformation	● Perform FEA simulations with minimal guidance, demonstrating understanding of	● Aerospace Industry: Ensuring tools can withstand high-stress conditions through FEA

	analysis on tool components. ● Motion simulation exercises to check tool performance under real-world conditions.	boundary conditions, materials, and loads. ● Correctly interpret FEA and motion simulation results to optimize designs, suggesting at least two improvements.	before production. ● Manufacturing: Validating tool designs under dynamic conditions to prevent failures during use.
Generate professional technical documentation, including 2D drawings, exploded views, and BOMs.	● Assignments for creating 2D technical drawings with GD&T symbols, dimensions, and annotations. ● Project submission for generating BOMs, exploded views, and assembly instructions.	● Generate complete, accurate technical drawings and exploded views with clear annotations, dimensions, and GD&T symbols. ● Provide a well-organized BOM and accurate assembly instructions.	● Engineering Firms: Producing drawings for production teams. ● Tooling Manufacturers: Generating documentation for the manufacturing and assembly of tools.
Develop a comprehensive tool design project applying all course concepts.	● Tool design project where students apply all learned concepts to develop a functional tool design, including 3D models, analysis, and documentation. ● Presentation	● Submit a fully functional tool design meeting the objectives with no errors in geometry or documentation. ● Present the project clearly and professionally, with a	● Custom Tool Development: Designing specialized tools for small-scale or niche applications. ● Research Projects: Creating innovative tools that solve specific engineering problems.

	of project outcomes to explain design decisions, improvements, and final product.	well-organized report and slides.	
Collaborate effectively in teams and present project outcomes professionally.	● Group project where students collaborate to create a tool design, with assigned roles for each team member. ● Peer review and feedback during the presentation phase.	● Actively contribute to the team, demonstrating strong collaboration and problem-solving skills. ● Present results with clarity, ensuring team contributions are well communicated.	● Cross-Disciplinary Teams: Working in multi-departmental teams to design tools and systems. ● Consulting Firms: Presenting tool design solutions to clients in a professional, organized manner.
Apply research, innovation, and course knowledge to solve real-world design challenges.	● Case study analysis to identify problems and propose solutions using learned techniques. ● Project-based problem solving, where students face realistic design challenges requiring creative solutions.	● Propose innovative solutions that meet technical and practical requirements. ● Demonstrate critical thinking by analyzing real-world cases and applying learned concepts to solve problems.	● Startups & Entrepreneurs: Developing unique solutions for new product lines or tools in niche markets. ● Industry R&D: Innovating and improving existing tools and manufacturing processes.

LIST OF FINAL PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)	
SL.NO	**FINAL PROJECT**
1	Jig and Fixture Design for Assembly Line Description: Design a custom jig and fixture for an automotive assembly line, focusing on ease of assembly and part alignment. Learning Outcome Covered: Parametric modeling, DFMA, technical documentation, assembly design.
2	Cutting Tool Design for CNC Machining Description: Create a cutting tool (e.g., drill, milling tool) for CNC machining, considering material selection, strength, and wear resistance. Learning Outcome Covered: Parametric modeling, FEA analysis, material selection, DFMA.
3	Custom Assembly Fixture for Product Testing Description: Design a fixture for testing a product prototype, ensuring it holds the product securely during testing. Learning Outcome Covered: Assembly design, motion analysis, technical documentation.
4	Automated Tool Changer Design for Robotics Description: Design an automated tool changer for a robotic arm, focusing on mechanical constraints and ease of operation. Learning Outcome Covered: Parametric modeling, FEA, motion analysis, assembly design.
5	Custom Die for Injection Molding Description: Create a mold for producing plastic parts using injection molding, considering thermal management and material flow.
6	Prototype Design for Automated Welding Jig Description: Design a welding jig that holds workpieces in place during automated welding processes. Learning Outcome Covered: Parametric modeling, DFMA, motion analysis, technical documentation.
7	Clamp Design for Heavy-Duty Machinery Description: Design a clamp that secures parts in place during machining operations, focusing on load-bearing capacity and safety. Learning Outcome Covered: Parametric modeling, FEA, DFMA, technical documentation.
8	Tooling for Precision Metal Cutting

	Description: Design a tool for precision metal cutting, including analysis of material properties and cutting forces. Learning Outcome Covered: Parametric modeling, FEA analysis, material selection, technical documentation.
9	Mold for Sheet Metal Forming Description: Design a mold used for forming sheet metal parts, ensuring smooth operation and reduced wear. Learning Outcome Covered: Parametric modeling, DFMA, technical documentation.
10	Product Assembly Line Conveyor System Description: Design a modular conveyor system for assembly lines, focusing on tool access and product handling. Learning Outcome Covered: Assembly design, motion analysis, DFMA.
11	Custom Gripper for Robotic Arm Description: Design a gripper that can hold and manipulate a variety of products, focusing on adaptability and precision. Learning Outcome Covered: Parametric modeling, motion analysis, DFMA.
12	Tooling for Precision Injection Molding Description: Create precision tooling for injection molding, focusing on minimizing defects and ensuring part consistency. Learning Outcome Covered: Parametric modeling, FEA, material selection, DFMA.
13	Tool Design for Composite Material Lay-Up Description: Design a tool for the lay-up process in composite materials, focusing on material placement and alignment. Learning Outcome Covered: Parametric modeling, DFMA, technical documentation.
14	Cutting Tool for High-Speed Machining Description: Design a high-speed cutting tool for a CNC machine that can withstand high temperatures and cutting forces. Learning Outcome Covered: Parametric modeling, FEA, material selection, DFMA.
15	Tool Design for Laser Engraving System Description: Design the tool holding mechanism for a laser engraving system, ensuring precision and easy adjustments. Learning Outcome Covered: Assembly design, motion analysis, technical documentation.
16	Assembly Tool for Electric Vehicle (EV) Battery Pack Description:

	Design a tool used to assemble battery packs for electric vehicles, ensuring ease of handling and minimizing damage. Learning Outcome Covered: Parametric modeling, DFMA, technical documentation, assembly design.
17	Die for Stamping Automotive Parts Description: Create a stamping die for mass production of automotive body parts, focusing on durability and precision. Learning Outcome Covered: Parametric modeling, DFMA, material selection, technical documentation.
18	Multi-Function Tool Design for Aerospace Applications Description: Design a multi-function tool used in aerospace assembly, considering versatility and safety. Learning Outcome Covered: Parametric modeling, assembly design, FEA, motion analysis.
19	Packaging Tool for Electronic Components Description: Design a tool that assists in the packaging of delicate electronic components, ensuring protection and ease of handling. Learning Outcome Covered: Parametric modeling, DFMA, technical documentation.
20	Tooling for Additive Manufacturing (3D Printing) Description: Design a specialized tool used in 3D printing processes to ensure material quality and precision. Learning Outcome Covered: Parametric modeling, DFMA, technical documentation, material selection.

ANNEXURE III

COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 70)				
ASSESSMENT CRITERIA	**DESCRIBE THE CRITERIA OF THE BELOW CATEGORY PERFORMANCE**			**TOTAL MARKS**
	FAIR	**GOOD**	**EXCELLENT**	
1. Parametric Modeling and Design	Model shows significant errors or omissions in parametric features.	Model is mostly correct with minor parametric issues.	Fully functional model with advanced constraints and features.	10
2. Design for Manufacturing and Assembly (DFMA)	Some DFMA principles applied, but design has multiple inefficiencies.	Design optimized with some inefficiencies.	Fully optimized design, minimized part count and cost, easy to manufacture.	10
3. Finite Element Analysis (FEA)	FEA applied with noticeable errors or lack of design adjustments.	FEA performed but some minor issues in analysis or interpretation.	Accurate and complete FEA with results used to optimize the design.	10
4. Motion Analysis and Kinematics	Motion analysis is incomplete or inaccurate.	Correct motion analysis but with minor errors in part interactions or movement.	Accurate motion simulation with detailed analysis and correct results.	10
5.Technical Documentation and Detailing	Drawings incomplete or inaccurate, missing GD&T or BOM.	Drawings are mostly correct, with minor GD&T or BOM issues.	Detailed and clear drawings with correct GD&T and BOM, professional-level documentation.	10
6.Real-World Problem Solving and Innovation	Basic solution with limited innovation or impact.	Solid solution with some creativity, but lacks	Highly innovative solution with clear impact on design efficiency.	8

		significant innovation.		
7. Project Integration and Final Presentation	Project integration is incomplete, presentation lacks clarity or detail.	Solid project integration, clear presentation with minor organizational issues.	Fully integrated project, clear and organized presentation, professional-level communication.	12