Reverse Engineering with Autodesk Fusion 360: Mesh to Parametric CAD

Target Audience

This course is designed for mechanical engineers, CAD designers, product developers, and reverse engineering professionals who want to learn how to transform mesh data into parametric CAD models using Fusion 360. It is suitable for learners working on product redesign, legacy part modeling, and industries requiring accurate CAD reconstruction from scan data.

Course Outcomes

By the end of this course, participants will be able to:

- Understand reverse engineering workflows in Fusion 360.
- Import, inspect, and repair mesh data using Fusion's integrated mesh tools.
- Convert mesh bodies into BRep solids for parametric modeling.
- Align and orient scan data for design intent.
- Create sketches from mesh sections and apply constraints.
- Build parametric CAD models with manufacturable geometry.
- Apply advanced surface and freeform modeling using Fusion's Form environment.
- Perform hybrid modeling combining mesh and solid workflows.
- Validate CAD accuracy against mesh data.
- Finalize models for manufacturing and export into standard formats.
- Apply workflows to mechanical, plastic, and complex geometry case studies.

Course Objectives

- Provide a complete understanding of Fusion 360's reverse engineering capabilities.
- Train learners in mesh inspection, cleanup, and editing.
- Develop proficiency in mesh-to-BRep conversion and parametric modeling.
- Enable learners to reconstruct surfaces and freeform geometry using Form tools.
- Teach hybrid modeling strategies for incomplete or complex scans.

- Introduce accuracy validation methods and finalization workflows.
- Reinforce learning through industry-oriented case studies.

Course Outline

The course comprises **40 hours** of theory and labs and is divided into **16 different chapters**. Each chapter will be followed by hands-on lab exercises to reinforce learning and gauge understanding of the topics covered.

Table of Contents

PART 1: Fundamentals & Mesh Environment

Module 1: Introduction to Reverse Engineering

- Reverse engineering workflow in Fusion 360
- Difference: Mesh workspace vs Solid workspace
- Industry applications: Product redesign, legacy part modeling
- Data types: Mesh (STL/OBJ) vs BRep (solid)
- Overview of Fusion environments: Design, Mesh, Surface (Form)
- Limitations of Fusion in reverse engineering

Module 2: Interface & Data Import

- Fusion 360 interface: Data panel, browser, workspace switching
- Importing mesh files: STL, OBJ
- Units & scaling correction
- Mesh display settings: Shaded, wireframe
- Managing heavy mesh files
- Understanding mesh structure: Triangles, vertices, facets

Module 3: Mesh Inspection & Analysis

- Inspecting mesh quality: High vs low density regions
- Identifying issues: Holes, noise, spikes
- Section analysis: Cross-sectional inspection
- Measurement tools: Distance, diameter, angle

- Visual inspection using shading modes

Module 4: Mesh Cleanup & Editing (CORE – Fusion Strength)

- Mesh repair tools: Close holes, remove defects
- Mesh reduction: Adaptive vs uniform triangle reduction
- Mesh smoothing: Improve surface quality
- Remesh: Generate uniform mesh
- Plane cut: Trim unwanted areas
- Separate/combine mesh bodies
- Editing mesh regions: Select & modify specific areas

Module 5: Mesh to BRep Conversion

- Concept of mesh vs solid body
- Converting mesh to BRep: Triangle count limitations
- Reducing mesh before conversion
- Handling conversion failures
- Cleaning BRep after conversion
- Preparing model for parametric editing

PART 2: Sketch & Parametric Modeling

Module 6: Alignment & Orientation

- Align tool usage
- Move/Copy for positioning
- Setting origin and axes
- Aligning mesh to reference geometry
- Preparing model for sketching

Module 7: Sectioning & Sketch Creation

- Creating section planes
- Projecting mesh edges

- Creating sketches from mesh
- Curve fitting techniques
- Sketch cleanup: Simplifying geometry
- Applying constraints: Tangent, perpendicular, parallel
- Adding dimensions

Module 8: Parametric CAD Modeling

- Creating base features: Extrude, revolve
- Advanced features: Sweep, loft
- Feature-based modeling
- Editing timeline (parametric history)
- Applying design intent
- Creating manufacturable CAD
- Using symmetry and patterns

PART 3: Advanced Modeling & Freeform

Module 9: Surface & Form Modeling

- Introduction to Form (T-Spline) modeling
- Creating freeform geometry
- Editing control points
- Matching mesh shape using forms
- Converting form to solid
- Surface modeling basics

Module 10: Hybrid Modeling

- Working with mesh + solid together
- Combining BRep + mesh
- Editing converted geometry
- Handling incomplete scans

- Refining geometry

Module 11: Accuracy Validation

- Comparing mesh vs CAD
- Section analysis for accuracy
- Measuring deviations manually
- Identifying critical areas
- Ensuring dimensional accuracy

PART 4: Finalization & Output

Module 12: Model Finishing

- Adding fillets and chamfers
- Draft considerations
- Final geometry cleanup
- Preparing for manufacturing

Module 13: Export & Integration

- Export formats: STEP, IGES, STL
- Preparing CAD for CAM and 3D printing
- File optimization
- Handling export errors

PART 5: Industry Case Studies

Module 14: Mechanical Component

- Mesh cleanup and repair
- Mesh to BRep conversion
- Sketch extraction
- Parametric modeling
- Final validation

Module 15: Plastic Component

- Freeform modeling approach
- Surface reconstruction
- Draft handling basics
- Final CAD preparation

Module 16: Complex Geometry

- Organic shape handling
- Form modeling usage
- Hybrid modeling
- Precision validation