AUTODESK CAD/CAM/CAE

OVERALL COURSE OBJECTIVES:

Develop proficiency in digital manufacturing using Autodesk Fusion 360, understanding the modern principles of cloud computing, 3D modeling, generative design, and CNC machining. The course aims to equip learners with skills to engage in innovative product manufacturing across various industries, adaptive to evolving technology trends.

LEARNING OUTCOMES: On successful completion of the course the students shall be able to:

1. Grasp foundational concepts and techniques underpinning modern cloud computing, including software-defined architectures and virtualization.
2. Understand and apply 3D modeling, rendering, simulation, and computer-aided manufacturing concepts using Autodesk Fusion 360.
3. Use generative design for innovative product manufacturing encompassing part consolidation, performance enhancement, and weight reduction.
4. Develop CAD and CAM skills to build and manage CNC machines, advancing knowledge in multi-axis toolpaths and machining.
5. Grasp the principles and applications of collaborative product development environments, integrating design, engineering, and manufacturing processes.
6. Delve into Autodesk's manufacturing digital transformation, discussing elements such as digital manufacturing trends, sustainable design, and generative design.

CAD and Digital Manufacturing	Intro to Digital Manufacturing with Autodesk Fusion 360
	Autodesk Fusion 360 Integrated CAD/CAM/CAE
	3D Model Creation with Autodesk Fusion 360
	Engineering Design Process with Autodesk Fusion 360
	Manufacturing Process with Autodesk Fusion 360
Manufacturing Process Management - I	Introduction to CAD, CAM, and Practical CNC Machining
	3-Axis Machining with Autodesk Fusion 360
Manufacturing Process Management - II	Creating Toolpaths for a CNC Lathe
	Multi-Axis CNC Toolpaths
Generative Design for Manufacturing - I	Generative Design for Additive Manufacturing
	Generative Design for Industrial Applications
Generative Design for Manufacturing - II	Generative Design for Part Consolidation
	Generative Design for Performance and Weight Reduction

COURSE CONTENT:

Module 1 : Intro to Digital Manufacturing with Autodesk Fusion 360 [12 Hours]

This course introduces innovations in CAD and digital manufacturing, speaking to the rapid changes taking place that are forever transforming the future of making.

This course will also explore foundational concepts behind Autodesk® Fusion 360™ CAD/CAM. Fusion 360 is a cloud-based CAD/CAM tool for collaborative product development that combines industrial design, mechanical engineering, and machine tool programming into one software solution. Through a series of lectures and hands-on exercises, this course provides the core philosophy behind the software. By understanding how designs are both made and assembled, you'll learn to create better designs from the start.

After completing this course, you will be able to:

• Summarize an understanding of digital manufacturing, principles of sustainable design, and manufacturing processes.

• Explain and discuss how trends such as generative design and machine learning are influencing innovation, and how things are made.

• Demonstrate knowledge and skills in foundational concepts of Fusion 360 CAD/CAM software.

• Practice design collaboration and file management best practices using Fusion 360 cloud-based features

Sub-Topics
CAD Admininstration
Design Innovation Practices
Foundational Concepts
The future of manufacturing and innovation

Formative Assessments:
5 Graded Quizzes

Module 2 : Autodesk Fusion 360 Integrated CAD/CAM/CAE [12 Hours]

This course builds upon digital manufacturing trends and foundational CAD concepts discussed in Course 1 of this series by introducing Fusion 360 as a problem-solving tool. In this course, we take the next step in connecting CAD, CAM, and CAE through a series of short exercises on 3D modeling, rendering, simulation, and computer aided manufacturing.

After completing this course series, you will be able to:

• Demonstrate knowledge of and apply job entry level skills in computer aided design, computer aided engineering (CAE) and computer aided manufacturing (CAM) using Fusion 360 software.

• Describe and apply design based workflows for design, engineering and manufacturing using Fusion 360 software.

• Utilize Fusion 360 cloud based collaboration features for project sharing and design review.

Sub-Topics
CAM and 3D printing resources
Render, animation, and drawing
Sculpt and sheet metal
Simulation
Sketching and modeling

Formative Assessments:
7 Graded Quizzes

Module 3 : 3D Model Creation with Autodesk Fusion 360 [15 Hours]

In this course, through a series of lectures and hands-on lessons, we'll examine a designer's approach to the design and manufacturing process—from concept to 3D model. We'll start by applying design thinking to understand user needs, and then we'll explore design criteria as we dive deeper into Autodesk® Fusion 360™ sketching, modeling, rendering, and documentation features.

Sub-Topics
2D Sketches to 3D Solid Model
Conceptual Design
Generative Wing Design
Photorealistic renderings

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 4 : Engineering Design Process with Autodesk Fusion 360 [15 Hours]

This course provides a deeper exploration of mechanical assemblies and simulation, which are key engineering features of the design and manufacturing process. The foundation of engineering design is exploration and iteration. Design is rarely a perfectly linear and straightforward process. In this course, we'll explore mechanical assembly design and simulation, focusing on testing and improving design components and performance. As we move through design assumptions, testing, and refining design ideas, we'll come closer to a final design, while developing a deeper knowledge in Autodesk® Fusion 360™ for simulating and analyzing product functionality.

After completing this course, you will be able to:

• Describe the engineering design process and workflow in Fusion 360.

• Summarize the trends that are influencing the design industry.

• Demonstrate knowledge and skills in more advanced Fusion 360 CAD and simulation skills

Sub-Topics
Assembly Motion
Camera Gimbal Design Integration
Design Optimization
Design Validation

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 5 : Manufacturing Process with Autodesk Fusion 360 [13 Hours]

Designing a product is only part of the process. Now, can that product be manufactured? A CNC machinist works with computer numeric controlled (CNC) machines from generating the machine code to machine setup and run. Understanding both CAD and CAM is essential to this portion of a design. Even if you are not the end user who programs a machine, it is invaluable to know how it's done. This knowledge translates directly to part design by helping make intelligent design decisions with manufacturing in mind. This course introduces you to the integrated CAD/CAM approach behind Fusion 360 CAD/CAM as well as 3D printed design setup and finally assembly and testing. All stages of product design in one place!

After completing this course, you will be able to:

• Explain the Fusion 360 integrated CAD/CAM manufacturing workflow.

• Summarize the trends that are influencing the future of manufacturing.

• Demonstrate knowledge and skills in foundational concepts of Fusion 360 CAD/CAM software.

• Set up a Flight Controller.

• Assemble a quadcopter.

• Fly the final design.

Sub-Topics
Propeller Program
Quadcopter Assembly
Setup and Test Flights
Waterjet Program

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 6 : Introduction to CAD, CAM, and Practical CNC Machining [20 Hours]

This course introduces you to the foundational knowledge in computer-aided design, manufacture, and the practical use of CNC machines. In this course we begin with the basics in Autodesk® Fusion 360™ CAD by learning how to properly sketch and model 3D parts. Before we program any

toolpaths, we'll explore CNC machining basics to ensure we have the ground level foundational knowledge needed to effectively define toolpaths. Finally, we explore the basics of setting up a CAM program and defining toolpaths to cut simple geometry. This is the same basic process that gets repeated for the design and manufacture of any part and is a critical step in learning and understanding the process.

Sub-Topics
Autodesk Fusion 360 Foundational Design concepts
CNC and machining basics
Create a CNC program
Setting up CAM programs

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 7 : 3-Axis Machining with Autodesk Fusion 360 [28 Hours]

As our machining geometry gets more complicated, Autodesk® Fusion 360™ is up to the task! With a host of standard and adaptive toolpaths we can rapidly remove material from even the most complicated 3d parts. In this course, we explore how to rough and finish geometry that requires tool motion in X, Y, and Z simultaneously, learning how to finish even the finest of details. We'll wrap up this course by creating a full CNC program for a part, simulating it, and exporting it to G-code.

Sub-Topics
Create fine detail finishing toolpaths
Creating a Complete CNC Program
Set up and job prep for 3-axis machining
Understanding and applying adaptive toolpaths

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 8 : Creating Toolpaths for a CNC Lathe [18 Hours]

CNC machines come in an almost endless array of configurations for various applications. So far, we have only talked about CNC Mills. More specifically vertical milling centers. In this course we turn our attention to the CNC Lathe. We identify the difference in a lathe's coordinate system, tools, and how to create lathe specific toolpaths.

Sub-Topics
CNC lathe stock handling
Internal and external grooving toolpaths
Set up and cut a profile
Threading, chamfering and C-Axis operations for turning

Formative Assessments:
1 Graded Quiz & 1 Peer Review Assignment

Module 9 : Multi-Axis CNC Toolpath [27 Hours]

Computer Numerical Controlled machines, or CNC for short, can have a nearly endless number of options. Most machines today control tool motion in 3-axes, X, Y and Z, but can be upgraded to include a 4th or 5th axis as well, A and B. Additionally, there are many machines on the market that are already 5-axis capable. The good news is that Autodesk® Fusion 360™ has you covered if you need to control multi-axis positioning or simultaneous motion in all 5 axes at once!

Sub-Topics
Creating Multi-Axis Positioning Toolpaths
Creating Multiple Setups
Creating Multiple Setups for Multiple Machines
Simultaneous Multi-Axis Toolpaths

Formative Assessments:
1 Graded Quiz & 1 Peer Review Assignment

Module 10 : Generative Design for Additive Manufacturing [26 Hours]

This course introduces you to one of the more common applications of generative design: Additive Manufacturing or 3D printing as it's also known. In this course, we explore the basics of geometry creation and the mindset shift needed to build a generative design—a deeper understanding of generative design, its parameters, and how to work with the results specifically aimed at making a 3D printed metal part. We develop insightful understanding of the generative workflow by exploring Autodesk® Fusion 360™ tools and combining them with the creative process of taking an idea to a 3D model. We'll learn how to focus on where a design is and isn't and apply the generative design thinking process to define a study as we take a deeper dive into Fusion 360.

Sub-Topics
Defining a Generative Setup
Post Process a Generative Design for Additive Manufacturing
What is Generative Design?
Working with Generative Design Outcomes

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 11 : Generative Design for Industrial Applications [28 Hours]

The foundation of engineering design is exploration and iteration. Design is rarely a perfectly linear and straightforward process. In this course, we explore a design for a traditional manufacturing method and use generative design to create the perfect iteration of it. From that point, we'll reverse engineer the generative design and recreate it for a traditional manufacturing method and explore the option of fabricating the generative version to weigh the pros and cons of each.

Sub-Topics
Defining a Generative Setup and Reviewing Outcomes
Reverse Engineering a Generative Design
Reviewing and Refining a Design
Working with an Initial Design

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 12 : Generative Design for Part Consolidation [27 Hours]

Designing a product is only part of the process. Now, can that product be manufactured? In many cases the end product is made up of an assembly of different pieces to simplify manufacturing. With generative design and additive manufacturing, we can now take a different approach to the process of designing and producing complex products by ultimately reducing the number of parts and steps in an assembly while optimizing a design for strength and weight reduction.

Sub-Topics
Beneficial Knowledge for Working with Generative Designs
Review and Analyze a Complex Assembly
Select and Post Process an Outcome to Finalize a Design
Set up a Generative Study

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

Module 13 : Generative Design for Performance and Weight Reduction [27 Hours]

There are many considerations and factors that play a part in designing a new product. Cost is usually a big one, but sometimes there are other factors that are the main contributors to a product's direction. With vehicles, specifically motorcycles, we see advanced engineering practices performed on seemingly minor parts. In some instances, making a part as light as possible can have a big effect on performance. In other cases, the strength or stiffness of a part, such as a motor mount, is more critical than its mass. Generative design allows us the ability to solve for both problems at the same time and make informed design decisions without the sacrifice. In this course, we'll explore how generative design can be applied to motorcycle parts to help reduce mass while also increasing performance.

Sub-Topics
Identifying and Modeling Obstacle and Preserve Regions
Post Process a File for Production
Review and Select an Outcome
Setting up a Generative Design Study

Formative Assessments:
5 Graded Quizzes & 1 Peer Review Assignment

ASSESSMENT:

For summative assessments, Coursera will provide question banks for which exams can be conducted on the Coursera platform or the faculty will create their own assessments.

Note: If a Course or Specialization becomes unavailable prior to the end of the Term, Coursera may replace such Course or Specialization with a reasonable alternative Course or Specialization.