Product Design Engineering and Modelling (MECH)

Course Learning Objectives	• Demonstrate the principles and significance of 3D modeling in product design. • Explore the features of Siemens NX software and navigate its user interface efficiently. • Gain proficiency in basic sketch creation and 3D modeling concepts. • Develop advanced 3D modeling skills, including creating complex solids and utilizing advanced sketch tools. • Learn assembly creation, component relationships, and perform interference checks. • Acquire drafting basics skills, including generating orthographic views and applying dimensions.
Course Outcomes	• Exhibit the fundamentals of 3D modeling and its significance in product design, along with its applications in various industries. • Apply proficiency in using Siemens NX software for 3D modeling, including exploring its features and user interface. • Create basic sketches and convert them into 3D models using extrusion, revolution, and sweeps. • Implement advanced 3D modeling techniques to create complex 3D solids from intricate sketches, utilizing sketch-based features, fillets, chamfers, shells, and patterns. • Develop the ability to assemble components in NX, define relationships and constraints, and perform interference and clearance checks in assemblies. Additionally, learn drafting basics to generate orthographic views, dimensions, and exploded views for clear communication of designs.

Course Duration: 45 Hours

Unit 1: Introduction to 3D Modeling and NX Software

What is 3D modeling and its significance in product design-Applications of 3D modeling in various industries-Importance of 3D modeling in the product development lifecycle-Introduction to Siemens NX software and its features- Exploring the user interface and different toolbars- Understanding the key functionalities of NX for 3D modeling- NX installation process and system requirements- Configuring the software settings for optimal performance- Creating a new project and workspace for 3D modeling- Understanding the various components of the NX user interface - Manipulating 3D views: Zoom, Pan, Rotate, and Fit- Introduction to perspective and orthographic views

Unit 2: Basic Sketch Creation and 3D Modeling Concepts

Creating lines, arcs, circles, and rectangles in NX sketching-Applying constraints and dimensions to maintain sketch integrity- Using sketch tools for precision and accuracy-Moving, copying, rotating, and scaling sketch elements- Applying changes to sketches and assessing their impact on 3D models- best practices for efficient sketch editing- Extrusion - Revolution- Sweeps.

Unit 3: Advanced 3D Modeling Features

Creating complex 3D solids from more intricate sketches-Exploring advanced sketch tools for sophisticated designs- Utilizing sketch-based features for organic shapes- Fillet -Chamfer - Shell - Creating patterns to replicate features or bodies- Linear and circular patterns for efficient design- Utilizing pattern features to save time in modeling.

Unit 4: Creating an Assembly and Managing Relationships

Understanding the concept of assemblies in NX- Differentiating between parts and assemblies- Exploring the importance of assemblies in the design process- How to create a new assembly in NX- Importing existing components into an assembly- Learning about constraints and how they define relationships between components- Understanding various types of constraints (mate, align, insert, etc.)-Performing

interference checks to identify and resolve conflicts between components- Generating assembly exploded views.

Unit 5: Drafting Basics

Generating top, front, and side orthographic views in drafting- Arranging views for clear communication of the design- best practices for presenting assemblies in drafting- Adding linear dimensions to indicate lengths and distances- Applying angular dimensions to specify angles- Using radial dimensions for circular features.

Test Projects:

Use Cases:

1: Basic Understanding of Model

- Task1: Open Siemens NX software and create a new project and workspace.
- Task2: Explore the user interface and different toolbars.
- Task3: Manipulate 3D views using Zoom, Pan, Rotate, and Fit commands.
- Task4: Understand the difference between perspective and orthographic views.
- Task5: Save the project.

2: Sketching Basics

- Task1: Create a new sketch and draw a rectangle using the sketch tools.
- Task2: Apply constraints and dimensions to the rectangle for precision.
- Task3: Add a circle inside the rectangle using sketching tools.
- Task4: Move and scale the circle within the sketch.
- Task5: Save and exit the sketch.

3: 3D Modeling Basics

- Task1: Extrude the sketch from Exercise 2 to create a 3D solid.
- Task2: Apply a fillet to one of the edges of the 3D model.

• Task3: Create a circular hole through the 3D model using the Hole command.

• Task4: Rotate the model to view it from a different perspective.

• Task5: Save the 3D model.

4: Assembly Basics

• Task1: Create a new assembly project.

• Task2: Import the 3D model from Exercise 3 into the assembly.

• Task3: Add a new part (simple cube) to the assembly.

• Task4: Use constraints to position the parts relative to each other.

• Task5: Save the assembly.

5: Drafting Basics

• Task1: Generate top, front, and side orthographic views of the assembly.

• Task2: Arrange the views for clear communication of the design.

• Task3: Add linear dimensions to indicate lengths on the drawing.

• Task4: Apply angular dimensions to specify angles within the assembly.

• Task5: Save the drafting project.

6: Advanced Sketching

• Task1: Create a new sketch and draw a complex shape using advanced sketch tools.

• Task2: Apply constraints and dimensions to maintain the integrity of the sketch.

• Task3: Use sketch tools for precision and accuracy in creating intricate designs.

• Task4: Move, copy, and rotate sketch elements within the sketch.

• Task5: Save and exit the advanced sketch.

7: Advanced 3D Modeling

- Task1: Create a new 3D model using a more intricate sketch from Exercise 6.
- Task2: Utilize advanced sketch-based features such as sweep or loft.
- Task3: Apply a shell feature to hollow out a part of the 3D model.
- Task4: Create a linear pattern to replicate a feature on the 3D model.
- Task5: Save the advanced 3D model.

8: Advanced Assembly

- Task1: Create a new assembly with multiple components.
- Task2: Import the advanced 3D model from Exercise 7 into the assembly.
- Task3: Use constraints to define relationships between components.
- Task4: Perform interference checks to identify and resolve conflicts.
- Task5: Save the advanced assembly.

9: Fillet and Chamfer

- Task1: Open the 3D model from Exercise 7.
- Task2: Apply a fillet to one set of edges on the 3D model.
- Task3: Apply a chamfer to another set of edges on the 3D model.
- Task4: Rotate the model to inspect the fillet and chamfer features.
- Task5: Save the model.

10: Hole Creation

- Task1: Open the 3D model from Exercise 9.
- Task2: Add a circular hole to a specific location on the 3D model.
- Task3: Adjust the size and depth of the hole using the Hole command.

- Task4: Rotate the model to ensure the hole does not interfere with other features.
- Task5: Save the model.

11: Sketching Practice

- Task1: Create a new sketch and draw a polygon using sketching tools.
- Task2: Apply geometric constraints to maintain the shape of the polygon.
- Task3: Add dimensions to the sides of the polygon for accuracy.
- Task4: Use sketch tools for efficient editing, such as moving and copying elements.
- Task5: Save and exit the sketch.

12: 3D Modeling Challenge

- Task1: Extrude the sketch from Exercise 11 to create a 3D model.
- Task2: Apply a revolve feature to a specific section of the 3D model.
- Task3: Create a new sketch on a face of the 3D model and add additional features.
- Task4: Apply a shell feature to the 3D model.
- Task5: Save the advanced 3D model.

13: Assembly Integration

- Task1: Create a new assembly project.
- Task2: Import the 3D model from Exercise 12 and another part.
- Task3: Use constraints to assemble the components into a coherent structure.
- Task4: Perform an interference check to ensure proper component alignment.
- Task5: Save the assembly.

14: Assembly Exploded View

- Task1: Open the assembly from Exercise 13.
- Task2: Generate an exploded view to illustrate the individual components.
- Task3: Adjust the spacing between components for clarity.
- Task4: Add annotations to highlight key features in the exploded view.
- Task5: Save the exploded view.

15: Drafting Refinement

- Task1: Open the drafting project from Exercise 14.
- Task2: Enhance the drafting layout by adjusting the arrangement of views.
- Task3: Add detailed annotations to describe features within the drawing.
- Task4: Apply a section view to showcase internal details of the assembly.
- Task5: Save the refined drafting project.

16: Parametric Sketching

- Task1: Create a new sketch and draw a parametric shape using variables.
- Task2: Explore the use of parameters to control dimensions in the sketch.
- Task3: Modify the parameters to observe the impact on the sketch.
- Task4: Apply constraints to ensure the sketch adjusts dynamically.
- Task5: Save and exit the parametric sketch.

17: Advanced 3D Modeling Challenge

- Task1: Create a new 3D model using a parametric sketch from Exercise 16.
- Task2: Utilize advanced features such as loft or sweep to add complexity.
- Task3: Apply multiple fillets and chamfers to different edges of the model.
- Task4: Integrate a circular pattern to replicate a feature.
- Task5: Save the advanced 3D model.

18: Assembly Motion Study

- Task1: Open the assembly from Exercise 17.
- Task2: Explore motion simulation by creating a simple animation.
- Task3: Define motion constraints and animate the movement of components.
- Task4: Adjust the animation timeline for different motion scenarios.
- Task5: Save the assembly with the motion study.

19: Drafting Detailing

- Task1: Open the drafting project from Exercise 18.
- Task2: Add detailed dimensions to specify tolerances in the drawing.
- Task3: Incorporate geometric tolerancing for critical features.
- Task4: Include annotations for surface finishes and material specifications.
- Task5: Save the detailed drafting project.

20: Final Project

- Task1: Create a new project that integrates elements from Exercises 1-19.
- Task2: Develop a 3D model, assemble components, and generate a detailed drawing.
- Task3: Apply best practices learned throughout the exercises.
- Task4: Verify the design through interference checks and motion studies.
- Task5: Save and document the final project.

Student Assessment Plan:

Each of the above-mentioned test projects will be divided into tasks by the training partner for each specific institution. Such tasks will be jointly evaluated by the faculty and the training partner and the following weightage is to be followed.

- 70% weightage to the external practical assessment.
- 30% weightage to the internal assessment.

Final Test Project/External Assessment Plan:

The Final Test Project will be chosen from the list given above, jointly by the college faculty and the Training Partner. The Final Test Project will be assessed on the following tasks, for 70%

Details	**Marks**
Task: 1	20
Task: 2	20
Task: 3	20
Task: 4	20
Task: 5	20

Employment Potential:

This course shall enable mechanical, automobile and allied domain Engineers to get employment in sectors like Manufacturing, Automotive Industries, construction, Graphics design and etc.