Introduction to 3D Printing

Course Duration: 6 Hours
Course Level: Beginner / Introductory
Mode of Instruction: live demonstration, guided hands-on practice,Interactive discussion and Q&A

Course Description

This course provides a comprehensive, hands-on introduction to 3D printing and additive manufacturing. Learners progress from understanding digital 3D models and slicing parameters to operating printers responsibly, troubleshooting common failures, designing functional household items, and evaluating real-world applications. Emphasis is placed on responsible 3D printing, material behavior, print reliability, and informed decision-making.

Overall Learning Outcomes

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

1. Prepare, slice, and print 3D models using an FDM 3D printer.
2. Operate a 3D printer safely and responsibly.
3. Identify and resolve common 3D printing issues.
4. Design simple functional objects with correct measurements and tolerances.
5. Select appropriate materials, settings, and printers for intended use.
6. Explain the role of additive manufacturing in modern production.

Course Outline

Lesson 1 – Digital Models, Slicing, and Print Preparation (1 Hour)
Topics Covered

- What is a 3D model (STL, 3MF)
- Relationship between digital geometry and physical prints
- Slicing fundamentals:
  - Temperature
  - Print speed
  - Layer height and surface quality
- G-code generation and transfer methods to start the print

Learning Outcomes

1. Explain how a 3D model is converted into printer instructions.
2. Adjust slicing parameters to control print quality and time.
3. Generate and transfer G-code files to a 3D printer.
4. Start the print.

Lesson 2 – Printer Setup, First Layer & Build Plate Care (1 Hour)
Topics Covered

- Filament loading and unloading
- Build plate cleaning and surface preparation
- Bed leveling methods (manual and automatic)
  Z-offset adjustment
- Importance of the first layer

Learning Outcomes

1. Prepare a 3D printer for printing safely and correctly.
2. Explain the role of bed leveling and first-layer adhesion.
3. Identify visual signs of good and poor first layers.

Lesson 3 – Materials, Filament Handling & Print Strength (1 Hour)
Topics Covered

- Common materials: PLA, PETG, ABS, specialty filaments
- Material properties and use cases
- Strength considerations:
  - Layer orientation
  - Infill density and pattern\
  - Wall thickness

- **Filament-related issues**:
  - Moisture absorption
  - Brittle filament
  - Filament tangling and poor spooling
- Proper filament storage practices

Learning Outcomes

1. Select appropriate materials based on functional requirements.
2. Explain how print settings influence part strength.
3. Identify filament-related problems and apply preventive measures.

Lesson 4 – Troubleshooting & Responsible 3D Printing (1 Hour)
Topics Covered

- Common printing issues:
  - Nozzle clogging
  - Poor bed adhesion
  - Warping
  - Under- and over-extrusion

- Causes and corrective actions
- **Responsible 3D printing**:
  - Reducing failed prints and material waste
  - Energy awareness
  - Printing only when additive manufacturing is appropriate
  - Ethical and practical considerations

Learning Outcomes

1. Diagnose common 3D printing failures and apply corrective actions.
2. Perform basic maintenance to improve printer reliability.
3. Apply responsible practices to reduce waste and misuse of 3D printing.

Lesson 5 – Designing Functional Objects & Model Sources (1 Hour)
Topics Covered

- Where to find 3D models (free vs paid, licensing basics)
- Designing **household and functional items**
- Taking accurate **measurements** using basic tools
- Understanding **tolerances, clearances, and fit**
- Design-for-3D-printing principles:
  - Wall thickness
  - Overhangs
  - Part orientation

Learning Outcomes

1. Locate and evaluate models suitable for functional printing.
2. Take measurements and apply tolerances in basic designs.
3. Design or modify simple household items for reliable printing.

Lesson 6 – Manufacturing Context, Applications & Printer Selection (1 Hour)
Topics Covered

- What is additive manufacturing
- Comparison with traditional manufacturing methods
- Overview of major 3D printing technologies (FDM, SLA, SLS)
- Practical applications of 3D printing
- How to choose a first 3D printer:
  - Budget and total cost of ownership
  - Build volume and reliability
  - Material compatibility
  - Community support and spare parts

Learning Outcomes

1. Distinguish additive manufacturing from traditional manufacturing.
2. Identify suitable use cases for different 3D printing technologies.
3. Evaluate and select an appropriate beginner-friendly 3D printer.