



**CENTRE OF EXCELLENCE  
IN MARITIME AND SHIPBUILDING**



# ADDITIVE MANUFACTURING: FROM DESIGN TO PRODUCTION

**Course Duration: 3 Days**



## DELIVERY MODEL:

### FULL OFFLINE DELIVERY AT IIT TIRUPATI

- **Morning Sessions (Theory):** Delivered by IIT Tirupati Faculty. Focus on scientific principles, material science, and advanced engineering concepts.
- **Afternoon Sessions (Practical):** Delivered by CEMS and IIT Tirupati Trainers. Focus on hands-on software training and operation of industrial 3D printers.

## TARGET PARTICIPANTS:

**20-30 INDUSTRIAL PROFESSIONALS**

## PARTICIPANT PREREQUISITES

To ensure an optimal learning experience, participants should possess the following foundational knowledge:

- **Academic Foundation:** A basic understanding of physics and chemistry concepts. Familiarity with fundamental engineering mechanics and properties of materials is highly beneficial.
- **Technical Familiarity:** Basic proficiency in navigating Windows-based software and operating a computer. Prior exposure to any CAD software is a strong advantage, but not mandatory.
- **General Proficiency:** An understanding of basic manufacturing processes and a keen interest in advanced digital technologies.



## EXPECTATIONS FROM THIS COURSE

This intensive workshop is designed to bridge the gap between theoretical knowledge and industrial application. Participants can expect to:

- Gain a strong foundational understanding of the science behind Additive Manufacturing processes and materials.
- Develop practical, hands-on skills in CAD modeling, print preparation, and operating industrial FDM, SLA, and SLM 3D printers.
- Learn to identify, troubleshoot, and solve common printing problems.
- Understand how to evaluate the feasibility of using AM for a real-world project, considering both technical and economic factors.
- Receive instruction and guidance from renowned faculty from IIT Tirupati and expert trainers from CEMS and IIT Tirupati.
- Network with professionals from various industries.

## LEARNING OUTCOMES

Upon successful completion of this course, participants will be able to:

### A. THEORETICAL KNOWLEDGE (IIT TIRUPATI FOCUS):

- Explain the mathematical foundations of CAD modeling and the core principles of Design for Additive Manufacturing (DfAM).
- Classify AM technologies according to ASTM/ISO standards and describe their underlying scientific principles.
- Evaluate material properties to select appropriate materials for intended applications.
- Analyze the impact of key process parameters on the mechanical properties and quality of a printed part.
- Identify appropriate metrology and quality assurance techniques for validating AM part integrity.

## B. PRACTICAL SKILLS (CEMS AND IIT TIRUPATI FOCUS):

- Develop a 3D solid model using NX software and prepare it for printing by generating and validating an STL file, including repairing common mesh errors.
- Operate slicing software to configure print parameters, generate toolpaths, and export G-code.
- Execute a print job safely on FDM, SLA, and SLM industrial 3D printers and perform basic maintenance and post-processing.
- Troubleshoot common print quality issues by correlating visual defects to their root causes

## C. INTEGRATED UNDERSTANDING:

- Critically assess the economic and environmental trade-offs between additive and traditional manufacturing.
- Formulate a project plan for applying AM to a real-world problem, considering the entire workflow from design to finished part.



# INTEGRATED COURSE SCHEDULE: ADDITIVE MANUFACTURING: FROM DESIGN TO PRODUCTION

### Day 1: CAD Fundamentals and Preparing for Additive Manufacturing

- Morning (9:00 AM - 1:00 PM | IIT Faculty - Theory)

- o 9:00 AM - 11:00 AM: Introduction to CAD and Geometric Modeling

- Mathematical foundations (curves, surfaces, solid modeling).
- Introduction to Design for Additive Manufacturing (DfAM) principles.

- o 11:15 AM - 1:00 PM: Data Preparation and Preprocessing for AM

- STL file format: structure, resolution, and common errors.
- **Preprocessing steps: STL file repair and validation techniques.**
- Alternative formats (AMF, 3MF).

- Afternoon (2:00 PM - 6:00 PM | CEMS and IIT Tirupati Trainer - Practical)

- o 2:00 PM - 4:00 PM: Hands-on with NX Software - Part 1

- Sketching, constraining, and feature-based modeling techniques.

## o 4:15 PM - 6:00 PM: Hands-on with NX Software - Part 2

- Synchronous modeling, measurement commands.
- **Practical Exercise: Exporting, validating, and repairing.STL files.**

## Day 2: Additive Manufacturing Processes and Technologies

### • Morning (9:00 AM - 1:00 PM | IIT Faculty - Theory)

#### o 9:00 AM - 11:00 AM: AM Processes Overview

- Comparison of subtractive, formative, and additive manufacturing.
- ASTM/ISO classification of AM technologies.
- Process principles:
  - FDM (Material Extrusion)
  - SLA (Vat Photopolymerization)
  - SLM (Powder Bed Fusion – Metal AM)
  - DED (Directed Energy Deposition – Metal AM)
- Advantages, limitations, and application domains.
- Economic & environmental considerations.

#### o 11:15 AM - 1:00 PM: Materials and Process Physics

- Polymers, photopolymers, and metal powders.
- Thermal behavior, solidification, microstructure and properties.
- Defects in additive manufacturing.

### • Afternoon (2:00 PM - 6:00 PM | CEMS and IIT Tirupati Trainer - Practical)

#### o 2:00 PM - 4:00 PM: Introduction to Slicing Software

- Slicing models, process parameter configuration, process analysis.

#### o 4:15 PM - 6:00 PM: Slicing and Demonstration

- Generating toolpaths, exporting G-code.
- **Live Demonstration:** FDM, SLA, SLM printer workflows and operation



## Day 3: Hands-On 3D Printing, Quality, and Application

### • Morning (9:00 AM - 1:00 PM | IIT Faculty - Theory)

#### o 9:00 AM - 11:00 AM: Process Deep Dive & Advanced concepts

- **FDM:** Heat transfer, bonding, anisotropy.
- **SLA:** Photopolymerization kinetics.
- **SLM:** Residual stress, distortion, support strategies
- Introduction to topology optimization and lattice structures

#### o 11:15 AM - 1:00 PM: Quality Assurance and Project Planning

- **Defect identification and mitigation**
- **Metrology techniques (optical scanning, CT – overview**
- **ASTM/ISO standards in AM**
- **Workflow:** Design → Simulation → Build → Post-processing

### • Afternoon (2:00 PM - 6:00 PM | CEMS and IIT Tirupati Trainer - Practical)

#### o 2:00 PM - 4:00 PM: Hands-On Printing

- **FDM 3D Printing:** Operation, maintenance, and printing a sample.
- **SLA 3D Printing:** Operation, first print, post-processing.
- **SLM 3D Printing:** Operation, first print, post-processing.

#### o 4:15 PM - 6:00 PM: Analysis and Troubleshooting

- Printing custom models.
- Post-processing finished parts.
- **Troubleshooting** common print quality issues.
- Course wrap-up and Q&A.

**Date: 4<sup>th</sup> May to 6<sup>th</sup> May.**

**Fee: ₹20,000+ GST**

Venue Details

**The course will be conducted at IIT Tirupati.**

### CONTACT INFORMATION:

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