



## COURSE CONTENT

<b>Additive Manufacturing</b>								
<b>I Year I Semester: CAD/CAM</b>								
Course Code	Category	Hours/ Week			Credits	Maximum Marks		
2214002	Advanced	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
<b>Contact Classes: 45</b>	<b>Tutorial Classes: Nil</b>	<b>Practical Classes: Nil</b>			<b>Total Classes: 45</b>			
<b>Prerequisites: Basics of Manufacturing, Basic knowledge in Calculus, Physics, Thermodynamics, and Chemistry</b>								

### Course Overview:

This course introduces the fundamentals of Additive Manufacturing (AM), its history, processes, and applications. It covers liquid, solid, and powder-based AM systems along with rapid tooling techniques. Data formats, software tools, and mesh processing for AM are also discussed. Finally, industrial and medical applications highlight the practical significance of AM in various fields

### Course Objectives:

1. To understand the fundamentals for additive manufacturing and its terms
2. To know various types of liquid based and solid based AM technologies.
3. To know various types of powder-based AM technologies with LENS and rapid tooling.
4. To understand the various types of pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software's used in AM.
5. To know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields.

### Course Outcomes: After Completion of the Course, Students should be able to

1. Understand the fundamentals of prototyping and automated processes.
2. Analyse the utility and application of liquid and solid based AM systems.
3. Understand the concepts of powder-based AM systems and Rapid tooling.
4. Utilize the AM Data formats and software's.
5. Utilize the AM for various practical applications.

### **UNIT-I:**

Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

### **UNIT-II:**

Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication. Solid-based AM Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused

Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

#### **UNIT-III:**

Powder Based AM Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

#### **UNIT-IV:**

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques. AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab

#### **UNIT-V:**

AM Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems

#### **TEXTBOOKS:**

1. Rapid Prototyping: Principles and Applications, Chee Kai Chua, Kah Fai Leong and Chu Sing Lim, World Scientific Publishing Co, Third Edition, 2010.

#### **REFERENCEBOOKS:**

1. Rapid Manufacturing by D.T. Pham and S.S. Dimov, Springer, 2001.
2. Wholers Report 2000 by Terry Wohlers, Wohlers Associates, 2000.
3. Rapid Prototyping & Engineering Applications by Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

#### **ELECTRONIC RESOURCES:**

1. <https://nptel.ac.in/courses/112103306>
2. [https://onlinecourses.nptel.ac.in/noc26\\_mm14/preview](https://onlinecourses.nptel.ac.in/noc26_mm14/preview)
3. [https://onlinecourses.nptel.ac.in/noc22\\_me122/preview](https://onlinecourses.nptel.ac.in/noc22_me122/preview)

#### **MATERIALS ONLINE:**

1. Course template
2. Assignments
3. Model question paper–I
4. Model question paper–II
5. Lecture notes
6. E-Learning Readiness Videos (ELRV)