



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

ADDITIVE MANUFACTURING TECHNOLOGIES								
I SEMESTER: CAD/CAM								
Course Code	Category	Hours /Week			Credits	Maximum Marks		
		L	T	P		C	CIA	SEE
BCCD03	Elective	3	-	-	3	40	60	100
<b>Contact Classes:48</b>		<b>Tutorial Classes: Nil</b>		<b>Practical Classes: Nil</b>			<b>Total Classes:48</b>	
<b>Pre requisites: Automation in Manufacturing</b>								

### I. COURSE OVERVIEW:

The primary objective of this course is to build bridges between the gap of an idea and production. The term Additive manufacturing covers a spectrum of processes where a component can be fabricated directly from the computer aided design. Rapid prototyping is a group of methods used to rapidly manufacture a scale model of a physical part or assembly using three-dimensional CAD, and Computed Tomography (CT).

### II. COURSE OBJECTIVES:

**The students will try to learn:**

- I. The fundamentals of AM and different types of AM process and their applications.
- II. The principle, methods and advantages of Liquid, solid and Powder based RPT systems.
- III. The data format and software used in additive manufacturing
- IV. The applications of AM in various domains.

### III. COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

- CO1 Explain modern proto type product fabrication methods, types and need of additive manufacturing.
- CO2 Outline operating principles of Liquid and Solid based additive manufacturing for various size and shape of parts.
- CO3 Make use of rapid prototyping technologies with powered based depositing methods.
- CO4 Apply software tools for slicing and parametric controls for developing complex shapes.
- CO5 Identify engineering applications for multidisciplinary domains.

### IV. COURSE CONTENT:

#### MODULE -I: Introduction to Additive Manufacturing Techniques (09)

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.

#### MODULE -II: Liquid and Solid Based Additive Manufacturing (10)

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.

### **MODULE -III: Powder Based Rapid Proto Typing Systems and Tooling (10)**

Powder Based Rapid Prototyping 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.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Diecasting, SandCasting,3D Kel tool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

### **MODULE -IV: Additive Manufacturing Data Format and Additive Manufacturing Software (10)**

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.

### **MODULE -V: Additive Manufacturing Applications (09)**

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.

### **V. TEXT BOOKS:**

1. Chua C.K., Leong K.F, LIMC.S, “Rapid Prototyping: Principles and Applications”, World Scientific publications, 3<sup>rd</sup> edition, 2010.

### **VI. REFERENCE BOOKS**

1. D.T Pham, S. S. Dimov, “Rapid Manufacturing”, Springer, 1<sup>st</sup> edition, 2001.
2. Paul F Jacobs, “Rapid Prototyping& Manufacturing”, Wohlers Associates, 2000 ASME Press, 1<sup>st</sup> edition, 1996.
3. Frank W. Liou, “Rapid Prototyping & Engineering Applications”, CRC Press, Taylor & Francis Group, 2<sup>nd</sup> edition, 2011.

### **VII. WEB REFERENCES:**

1. <http://nptel.ac.in/courses/112107077/38>
2. [http://web.iitd.ac.in/~pmpandey/MEL120\\_html/RP\\_document.pdf](http://web.iitd.ac.in/~pmpandey/MEL120_html/RP_document.pdf)

### **VIII. E-TEXT BOOKS:**

1. [https://books.google.co.in/books?id=4OYcyiDUpsQC&redir\\_esc=y](https://books.google.co.in/books?id=4OYcyiDUpsQC&redir_esc=y)
2. <http://store.elsevier.com/Direct-Write-Technologies-for-Rapid-Prototyping-Applications/isbn-9780121742317/>

### VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. PowerPoint presentation