

<b>Devi Ahilya University, Indore, India Institute of Engineering &amp; Technology</b>				<b>III Year B.E. (Mechanical Engg.) (Full Time)</b>			
<b>Subject Code &amp; Name</b>	<b>Instructions Hours per Week</b>			<b>Credits</b>			
<b>5MERE3: Introduction to concepts and practices in 3D Printing</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>
	3	1	2	3	1	1	5
<b>Duration of Theory Paper: 3 Hrs</b>							

**Course Objective:**

The course is designed

1. To provide students with information and skills relevant to 3D printing technologies.
2. To enable the ability to appropriately select material and equipment needed.
3. To make students familiar in creation of products utilizing this process in an Industry 4.0 scenario.

**Prerequisite(s):** Material Science and CAD Software

**COURSE CONTENT**

**UNIT-I**

**3D Printing and CAD for Additive Manufacturing:** Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications. CAD Data formats, Data translation, Data loss, STL format.

**UNIT-II**

**Additive Manufacturing Techniques:** Stereo- Lithography (SL), Laminated Object Manufacturing, (LOM), Fused Deposition Modelling (FDM), Selective Laser Sintering (SLS), SLM, Binder Jet technology. Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.

**UNIT-III**

**Materials:** Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

**UNIT-IV**

**Additive Manufacturing Equipment:** Process Equipment- Design and process parameters. Governing Bonding Mechanism. Common faults and troubleshooting. Process Design.

**UNIT-V**

**Post Processing and Product Quality:** Requirement and Techniques. Inspection and testing. Defects and their cause.

### **List of Practical Assignments:**

1. 3D Modelling of a single component.
2. Assembly of CAD modelled Components.
3. Practice on CAD Data Exchange methods.
4. Generation of .stl files.
5. Identification of a product for Additive Manufacturing and its process plan.
6. 3D Printing of identified product on an available 3D printing machine.
7. Post processing of additively manufactured product.
8. Inspection and defect analysis of the additively manufactured product.
9. Comparative analysis of Additively manufactured product with conventional manufactured counterpart.

#### **Course Outcome:**

Students earned credits will develop ability to

- CO1. Generate CAD models for 3D printing.
- CO2. Import and Export CAD data and generate .stl file format.
- CO3. Choose appropriate material for the given application.
- CO4. Choose 3D printing process based on required application.
- CO5. Create a product using 3D Printing.

#### **Books Recommended:**

- [7]. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Second Edition, Springer, New York.
- [8]. Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, 3<sup>rd</sup> Edition, World Scientific Publishing Ltd.
- [9]. Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory & Practice”, Springer, 2006.
- [10]. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

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**Course Outcome:**

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Generate CAD models for 3D printing.	PO1, PO3, PO4, PO5
CO2	Import and Export CAD data and generate .stl file format.	PO1, PO3, PO4, PO5
CO3	Choose appropriate material for the given application.	PO1, PO2, PO7, PO12
CO4	Choose 3D printing process based on required application.	PO1, PO5, PO11, PO12
CO5	Create a product using 3D Printing.	PO1, PO4, PO7, PO12

**CO-PO Relationship**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	3		3	3	2							
CO2	3		3	3	3							
CO3	3	3					2					2
CO4	3				3						2	2
CO5	3			3			2					2

\* CO (rows) mention nil/very small/insignificant contribution to the PO(column)  
 1 → relevant and small significance    2 → medium or moderate    and    3 → strong