COURSE MODULE

Faculty Name: ANIL KUMAR K			Academic Year:**2023 - 2024**				
Department: **Mechanical Engineering**							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
18ME741	**Additive Manufacturing**	**Core**	**Basic Manufacturing concepts**	**3**	**-**	**-**	**40**

Course Objectives	**Course objectives: This course (18ME741) will enable students to:** **CLO1:** To know the principle methods, areas of usage, possibilities and limitations of the Additive Manufacturing technologies. **CLO2**: To be familiar with the characteristics of the different materials those are used in Additive Manufacturing. **CLO3**: To know the principles of polymerization and powder metallurgy process, extrusion-based system printing processes, sheet lamination processes, beam deposition processes, direct write technologies and Direct Digital Manufacturing. **CLO4**: To get exposed to process selection, software issues and post processing.

Topics Covered as per Syllabus

MODULE-I

Introduction and basic principles: Need for Additive Manufacturing, Generic AM process, stereolithography or 3dprinting, rapid proto typing, the benefits of AM, distinction between AM and CNC machining, other related technologies- reverse engineering technology.

Development of Additive Manufacturing Technology: Introduction, computers, computer-aided design technology, other associated technologies, the use of layers, classification of AM processes, metal systems, hybrid systems, milestones in AM development.

Additive Manufacturing Process chain: Introduction, the eight steps in additive manufacture, variations from one AM machine to another, metal systems, maintenance of equipment, materials handling issues, design for AM, and application areas.

MODULE-2

Photo polymerization processes: Stereolithography (SL), Materials, SL resin curing process, Microstereolithography, Process Benefits and Drawbacks, Applications of Photo polymerization Processes.

Powder bed fusion processes: Introduction, Selective laser Sintering (SLS), Materials, Powder fusion mechanism, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Extrusion-based systems: Fused Deposition Modelling (FDM), Principles, Materials, Plotting and path control, Bio-Extrusion, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.

MODULE - 3

Printing Processes: evolution of printing as an additive manufacturing process, research achievements in printing deposition, technical challenges of printing, printing process modeling, material modification methods, three-dimensional printing, advantages of binder printing

Sheet Lamination Processes: Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.

Beam Deposition Processes: introduction, general beam deposition process, description material delivery, BD systems, process parameters, typical materials and microstructure, processing–structure–properties relationships, BD benefits and drawbacks.

Direct Write Technologies: Background, ink -based DW laser transfer, DW thermal spray, DW beam deposition, DW liquid-phase direct deposition.

MODULE-4

Guidelines for Process Selection: Introduction, selection methods for apart, challenges of selection, example system for preliminary selection, production planning and control.

Software issues for Additive Manufacturing: Introduction, preparation of cad models – the STL file, problems with STL files, STL file manipulation.

Post- Processing: Support material removal, surface texture improvements, preparation for use as a pattern, property enhancements using non-thermal techniques and thermal techniques.

MODULE-5

The use of multiple materials in additive manufacturing: Introduction, multiple material approaches, discrete

multiple material processes, porous multiple material processes, blended multiple material processes, commercial applications using multiple materials, future directions.
AM Applications: Functional models, Pattern for investment and vacuum casting, medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Remanufacturing. Application: Examples for Aerospace, defence, automobile, Bio-medical and general engineering industries.
Direct digital manufacturing: Align Technology, siemens and phonak, DDM drivers, manufacturing vs. prototyping, life- cycle costing, future of direct digital manufacturing.

List of Text Books

1. Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing, I. Gibson l D. W. Rosen l B. Stucker, Springer New York Heidelberg Dordrecht, London.

List of Reference Books

1. "Rapid Prototyping": Principles & Applications Chua Chee Kai, Leong Kah Fai, World Scientific, 2003.
2. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015), Ian Gibson, David W. Rosen, Brent Stucker
3. "Understanding Additive Manufacturing", Andreas Gebhardt, Hanser Publishers, 2011

List of URLs, Text Books, Notes, Multimedia Content, etc

Video Demonstration of Different types of automation and Mechanisms
https://nptel.ac.in/courses/112/103/112103306/
https://www.youtube.com/watch?v=7L42aRs68WI
https://www.youtube.com/watch?v=gcia0aqZMf0

Printed Copy (Soft Copy): Available

Course Outcomes	**Students will be able to:** **CO1:** Understand the knowledge of AM process, Capabilities and distinction with respect to conventional manufacturing process. **CO2:** Describe the various process in additive manufacturing and advanced devices that satisfy product development/prototyping requirements. **CO3:** Understand the various software tools, processes and techniques that enable advanced/additive manufacturing. **CO4:** Discuss the latest trends and business opportunities in additive manufacturing.

Internal Assessment Marks: 40 (30 Marks three Session tests are conducted during the semester and marks allotted based on the average of three performances and additional 10 Marks for Assignments /Unit tests/ written quizzes).

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code:	18ME741		TITLE: Additive Manufacturing					Faculty Name:		ANIL KUMAR K		
List of Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2		2		3						2	3
CO-2	2		2		3						2	2
CO-3			3		3							
CO-4						3	2	0	0	2	3	

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution

The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO's)

Subject Code: 18ME741	TITLE: Additive Manufacturing	Faculty Name:	ANIL KUMAR K

List of Course Outcomes	Program Specific Outcomes	
	PSO1	PSO2
CO-1	3	3
CO-2	2	3
CO-3	0	0
CO-4	0	0

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution