

Faculty Name/s:			Academic Year:2026 - 27				
Department: Mechanical Engineering							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
18ME741A	Additive Manufacturing	Core	Basic Manufacturing concepts	3	-	-	40
Course Objectives	Course objectives: This course 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							
<u>MODULE-I</u>							
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.							
<u>MODULE-2</u>							
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.							
<u>MODULE - 3</u>							
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.							
<u>MODULE-4</u>							
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.							
<u>MODULE-5</u>							

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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 I D. W. Rosen I 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-Demonstrate the knowledge of the broad range of AM processes, devices, capabilities and materials that are available.
	CO2-Describe the various software tools, processes and techniques that enable advanced/additive manufacturing (SLS, FDM and SL).
	CO3-Apply the concepts of additive manufacturing to design and create components that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes (LOM, Beam deposition and direct write technology)
	CO4-Elucidate guidelines for Process Selection, Software issues, post processing characterization techniques, in additive manufacturing.
	CO5-Illustrate the latest trends, Applications and business opportunities in additive manufacturing.

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- The CIE is the sum of Average of Two Internal Assessment Tests each of 25 marks and Any two Assessment methods for 25 marks.
- The first test will be administered after 4050% of the syllabus has been covered, and the second test will be administered after 8590% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB , if an assignment is projectbased then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaledown sum of two tests and other methods of assessment for a total of 50 marks

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3

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sub questions), should have a mix of topics under that module.

3. The students have to answer 5 full questions, selecting one full question from each module. 4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources: Books

1. Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing I. Gibson I D. W. Rosen I B. Stucker Springer New York Heidelberg Dordrecht, London ISBN: 978 1 441911193 eISBN: 978 14419 11209 DOI 10.1007/978 14419 11209
2. "Rapid Prototyping: Principles & Applications Chua Chee Kai, Leong Kah Fai World Scientific 2003
3. Rapid Prototyping: Theory & Practice Ali K. Kamrani, Springer 2006 Emand Abouel Nasr,
4. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling" D.T. Pham, S.S. Dimov Springer 2001
5. Rapid Prototyping: Principles and Applications in Manufacturing Rafiq Nooran John Wiley & Sons 2006
6. Additive Manufacturing Technology Hari Prasad, A.V. Suresh Cengage 2019
7. Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing Andreas Gebhard

Activity Based Learning (Suggested Activities in Class)

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

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

Subject Code:	BME741A	TITLE: Additive Manufacturing						Faculty Name:				
List of Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	-	2	-	2	-	-	-	-	-	-	2
CO-2	2	-	2	-	2	-	-	-	-	-	-	2
CO-3	2	-	2	-	2	-	-	-	-	-	-	2
CO-4	2	-	2	-	-	-	-	-	-	-	-	2
CO-5	2	-	2	-	-	-	-	-	-	-	-	2

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: BME741A		TITLE: Additive Manufacturing	Faculty Name:	
List of Course Outcomes	Program Specific Outcomes			
	PSO1		PSO2	
CO-1	2		2	
CO-2	2		2	
CO-3	2		2	
CO-4	2		2	
CO-5	2		2	

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