

Branch Name:	Mechanical Engineering (Production Technology)
Program Code:	ET209
Course Name:	Additive Manufacturing
Course Code:	2ET2090402T
Pre-requisite Course:	Instructor's permission

Course Objectives:

- To acquaint students with the concept of Additive Manufacturing (AM), various AM technologies, selection of materials for AM, modeling of AM processes, and their applications in various fields.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
03	03	-	-	03	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction to Additive Manufacturing (AM): General overview Introduction to reverse engineering, Traditional manufacturing vis AM, Computer aided design (CAD) and manufacturing (CAM) and AM, Different AM processes and relevant process, physics AM process chain Processes-Rapid Prototyping, Rapid Tooling. Rapid Manufacturing; Indirect Processes-Indirect Prototyping. Indirect Tooling, Indirect Manufacturing	05	15
2	Materials science for AM: Discussion on different materials used, Use of multiple materials, multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, Structure property relationship, Grain structure and microstructure	04	10
3	AM Technologies: Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, electron beam melting involvement), Printing processes droplet based 3D, Solid-based AM processes, extrusion based fused deposition modeling, Object Stereo lithography, Micro-and Nano-additive.	12	30
4	Mathematical models for AM: Transport phenomena models: temperature, fluid flow and composition, buoyancy driven tension	1	30

	driven free surface flow pool. Case studies: Numerical Modeling of AM process, Powder bed melting based process, Droplet based printing process Residual stress, part fabrication time, cost, optimal orientation and optimal Defect in AM and role of transport Simulations (choice of parameter, Model validation)	3	
5	Process selection, Planning, Control for AM: Selection of AM technologies using decision methods, Additive manufacturing process plan: strategies and post processing. Monitoring and control of defects, transformation	6	15

Review Presentation:

The student is expected to refer at least two peer reviewed journal papers related to this domain/subject so as to identify issues/challenges and emerging trends. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same.

Recommended sites for journal papers are (1) asmedigitalcollection.asme.org (2) springer.com (3) sciencedirect.com (4) ieeexplore.ieee.org (5) scholar.google.co.in or others of similar repute.

List of Reference Books:

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive manufacturing technologies Rapid Prototyping to Direct Digital Manufacturing Springer, 2010.
2. Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid tooling, Rapid manufacturing, Hanser Publishers, 2011.
3. J. D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, e-ISBN: 978-3-642-28359-8.
4. L. Lu, J. Fuh and Y.-S. Wong, Laser-induced materials and processes for rapid prototyping, Kluwer Academic Press, 2001
5. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) Processes of titanium alloy, InTech, 2012.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Demonstrate a basic technical understanding of the physical principles, materials, and operation of the types of AM processes.	3 Applying
CLO2	Understand and use techniques for processing of CAD models for rapid prototyping.	2 Understanding
CLO3	Apply fundamentals of Additive Manufacturing techniques.	3 Applying
CLO4	Describe the relationships between AM process phenomena and part accuracy and surface finish.	2 Understanding
CLO5	Predict appropriate tooling for rapid prototyping process.	3 Applying 4 Analyze
CLO6	Distinguish Additive Manufacturing Processes and other related technology.	2 Understanding 6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	H		H		M							L	H	
CLO2		H		M			L		L				M	
CLO3			M			M		L			L			L
CLO4	H				M					M		M	M	
CLO5		M		L			M		M					H
CLO6	H		M		H		L				M			M

H:High, M:Medium, L:Low