

Branch Name:	Mechanical Engineering (Production Technology)
Semester/Year:	Semester II / Second Year
Subject Title:	Additive Manufacturing
Subject Code:	1ET2090402
Pre-requisite:	Instructor's permission

Course Objectives:

1. 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 Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	00	02	05	60	40	30	20	150

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 drop!et based 3D Solid-based AM processes - extrusion based fused deposition modeling object Stereolithography Micro- and nano-additive	12	30
4	Mathematical models for AM: Transport phenomena models: temperature, fluid flow and composition, buoyancy driven tension driven free surface flow pool	13	30

	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)		
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
		40	100

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. 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 (5) ieeexplore.ieee.org (6) scholar.google.co.in or others of similar repute.

Course Outcomes:

The student will be able to

1. demonstrate a basic technical understanding of the physical principles, materials, and operation of the types of AM processes.
2. demonstrate the ability to identify characteristics of parts that are fabricated by AM processes.
3. understand models of material processing phenomena and apply them to simulate AM process operations.
4. learn about the relationships between AM process phenomena and part accuracy and surface finish.

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.
6. C.K. Chua, K.F. Leong and C.S. Lim, Rapid prototyping: principles and applications, 3rd Edition, World Scientific, 2010.

List of Practical:

- Students shall exercise some case studies and perform hands-on practice on new/existing system based on the topics of syllabus and submit report of the same.