Course Type	Course Code	Name of the Course	L	T	P	Credit
DE	OMED607	Metal Additive Manufacturing	3	0	0	3

Prerequisites

The student should have completed two semesters of a UG Engineering or Science program

Course Objectives

1. Introduce fundamental concepts and process classifications in metal Additive Manufacturing (AM).
2. Cover design methodologies and material considerations specific to metals.
3. Explain the complete metal AM workflow from design optimization and modularity.
4. Detail advanced manufacturing techniques such as Powder Bed Fusion and Directed Energy Deposition.
5. Provide practical exposure through lab demonstrations and software tools.
6. Teach costing strategies and post-processing methods for metal AM.
7. Present real-world industrial case studies from relevant sectors.

Learning Outcome

1. Students will comprehend fundamental concepts and process classifications in metal Additive Manufacturing (AM) technologies.
2. Students will apply design-for-AM principles including topology optimization and support structure design.
3. Students will analyze material considerations and workflow from design to post-processing in metal AM.
4. Students will operate Powder Bed Fusion and Directed Energy Deposition manufacturing techniques.
5. Students will utilize CAD/CAE/CIM software tools for AM workflow integration and optimization.
6. Students will evaluate costing strategies and perform cost analysis for metal AM components.
7. Students will evaluate real-world industrial case studies in aerospace, automotive, and healthcare using metal AM.

Unit No.	Topics to be covered	No. of lecture videos	Video time (Minutes)	Learning Outcomes
1	Introduction to Additive Manufacturing (AM), Classification and Challenges	5	162	Explain solidification behavior, metal fluidity, and casting fundamentals
2	Modular Design and topology	3	152	Understand pattern design, mould properties, and testing methods for casting accuracy
3	Design freedom in AM	3	155	Design effective gating and riser systems to optimize casting quality and reduce defects
4	CAD for AM	4	166	Analyze metal melting techniques, casting design rules, and identify common casting defects
5	Metal AM physics and processes, Laser and Extrusion	4	171	Explain basic mechanical behavior of materials under load and their relevance in forming processes
6	Metal AM processes, Filament, Powder and Sheet Systems	3	140	Evaluate yielding behavior and mechanics behind various metal forming operations
7	Metal AM physics and processes, Directed Energy, Binder and Material Jetting	3	104	Analyze rolling and forging processes and perform basic force calculations
8	Feedstocks, metallurgy and properties of materials	4	150	Understand extrusion, wire/rod/tube drawing, and predict forming-related defects

9	Post processing and testing	4	141	Describe welding classifications, thermal behavior, and metallurgical transformations in weld zones
10	Reverse Engineering for metal AM	4	126	Compare different welding and joining processes and understand their operational principles
11	Modelling for AM	5	187	Identify sources of welding residual stresses and propose methods to minimize distortion
12	Value analysis, and future of metal AM	5	217	Assess material weldability and select suitable tests and approaches for different alloys
	Total	47	1871	

Textbooks:

1. Rapid Prototyping: Theory and Practice, Authors: Ali K. Kamrani, Emad Abouel Nasr

2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Authors: Ian Gibson, David Rosen, Brent Stucker

Reference Books

1. *Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling* Author: Paulo Bartolo