Devi Ahilya Vishwavidyalaya, Indore, India Institute of Engineering & Technology				**III Year B. Tech (Mechanical Engineering) (Full Time)**		
Course Code & Name	**Instructions Hours per Semester and Credits**					
5RMPE3: Introduction to concepts and practices in 3D Printing	**Classroom Instruction (CI)**		**Lab Instruction (LI)**	**Term Work (TW) and Self Learning (SL)**	**Total no. of Hours Per semester**	**Total Credits (Total Hours/30)**
	L	**T**	**P**	**TW+SL**	**120**	**4**
	20	**10**	**20**	**70**		

Course Learning Objectives:

1. Understand the fundamentals, classification, and standards of additive manufacturing (ASTM/ISO).
2. Develop CAD models and apply Design for Additive Manufacturing (DfAM) principles.
3. Select appropriate materials (polymers, metals, ceramics, composites, smart/biomaterials) for AM.
4. Analyze AM processes, equipment, and process monitoring using Industry 4.0 tools (IoT, AI, sensors).
5. Apply post-processing, inspection, sustainability, and business considerations to evaluate AM products.

Prerequisite(s): CAD Software knowledge.

COURSE CONTENT

UNIT-I

Fundamentals & CAD for AM: Evolution of AM, ASTM/ISO classification, advantages vs conventional manufacturing, CAD workflows, STL format, slicing, adaptive slicing, error repair, Design for Additive Manufacturing (DfAM): topology optimization, lattice structures.

UNIT-II

Additive Manufacturing Techniques: Processes: SLA, LOM, FDM, SLS, SLM, Binder Jet, DLP, CLIP, EBM, LENS, Cold Spray, Ultrasonic AM, Process parameters, calibration (bed levelling, extruder tuning), Application domains: aerospace, healthcare, automotive, defence, construction, food, textiles.

UNIT-III

Materials for AM: Polymers, metals, ceramics, composites, smart materials, bioactive materials, 4D/5D printing, Raw material forms: liquid, solid, wire, powder; powder preparation and properties, Sustainability in materials: recyclability, environmental impact.

UNIT-IV

Equipment & Process Monitoring: AM equipment design, bonding mechanisms, process parameters, Sensor integration, IoT, AI-based monitoring, digital thread, Troubleshooting and defect prediction using machine learning.

UNIT-V

Post-Processing, Quality & Business: Post-processing techniques: heat treatment, infiltration, rapid tooling, precision finishing, Inspection and metrology: CT scanning, dimensional accuracy, mechanical testing, Defects and root cause analysis, Business and sustainability: cost analysis, commercialization, environmental impact.

Course Outcomes:

CO. No.	CO	POs
CO1	Generate CAD models and apply DfAM principles.	PO1, PO2, PO3, PO5
CO2	Select and justify AM processes for specific applications.	PO1, PO2, PO3, PO4, PO5
CO3	Evaluate materials and sustainability aspects in AM.	PO1, PO2, PO3, PO4, PO5, PO7, PO8
CO4	Operate AM equipment and apply process monitoring techniques.	PO1, PO2, PO3, PO4, PO5
CO5	Perform post-processing, inspection, and business evaluation of AM products	PO1, PO2, PO3, PO4, PO5, PO7, PO8

Books Recommended:

[1]. Ian Gibson, David W Rosen, Brent Stucker, *Additive Manufacturing Technologies*, Springer.
[2]. Chua Chee Kai, Leong Kah Fai, *Rapid Prototyping: Principles & Applications*, World Scientific.
[3]. Ali K. Kamrani, Emand Abouel Nasr, *Rapid Prototyping: Theory & Practice*, Springer.
[4]. D.T. Pham, S.S. Dimov, *Rapid Manufacturing: Technologies and Applications*, Springer.
[5]. ASTM/ISO Standards for Additive Manufacturing (latest editions).

CO-PO-PSO Relationship

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
5RMPE3 .CO1	3	2	2	-	3	-	-	-	-	-	-	3	3	2
5RMPE3 .CO2	3	3	3	2	3	-	-	-	-	-	-	3	3	3
5RMPE3 .CO3	3	2	3	2	2	-	2	1	-	-	-	3	3	3
5RMPE3 .CO4	3	3	3	2	3	-	-	-	-	-	-	3	3	3
5RMPE3 .CO5	3	3	3	2	3	-	2	2	-	-	-	3	3	3

List of Lab/Practical Assignments:

1. CAD modeling and STL generation with error repair.
2. Study and Calibration of 3D printer (bed leveling, extruder tuning).
3. Printing of lattice structures/topology optimized parts.
4. Material characterization (FDM supported materials, powder flowability, polymer tensile testing).
5. Process monitoring with sensors/IoT integration.
6. Post-processing (surface finishing, heat treatment).
7. Defect analysis using inspection tools.
8. Comparative study: AM vs conventional manufacturing.
9. Mini-project: Design, print, and evaluate a functional prototype.
