GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree – 3 D Printing
Subject Code: N115AN01
Semester – V (w.e.f. AY 2025-26)
Subject Name: Materials for Additive Manufacturing

Prerequisite: None

Rationale: This course aims to familiarize students with basic fundamentals of Materials to be used for Additive Manufacturing.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	70
3	0	0	3	70	0	00	0	

Content:

Sr. No.	Content	Total Hrs.
1	**Plastic 3D Printing Materials and Processes:** Introduction to Thermoplastics and Thermosetting plastics. Types of Polymerizations, Properties of Polymers, Degradation of Polymers, Chemical, optical, mechanical, and thermal characteristics of plastics. Materials requirement based on Tensile strength, Flexural modulus, Elongation, Impact strength, Heat deflection temperature, Hardness (durometer), Tear strength, Creep, Compression set.	9
2	**Polymers & Its Processing:** Classification of polymers, Concept of functionality, Polydispersity and Molecular weight [MW], Molecular Weight Distribution [MWD], various methods of determination of MWD., Methods of spinning for additive manufacturing: Wet spinning, Dry spinning. Biopolymers, Compatibility issues with polymers.	8
3	**FDM 3D Printing Materials:** ABS (acrylonitrile butadiene styrene), PLA (polylactic acid), PETG (polyethylene terephthalate glycol), Nylon, TPU (thermoplastic polyurethane), PVA (polyvinyl alcohol), HIPS (high impact polystyrene), Composites (carbon fiber, kevlar, fiberglass)	7
4	**SLA 3D Printing Materials:** Resin formulations with a wide range of optical, mechanical, and thermal properties to match those of standard, engineering, and industrial thermoplastics. Types of resin (Standard Resins, Clear Resin, Draft Resin, Tough and Durable Resins, Rigid Resins, High Temp Resin, Flexible and Elastic Resins, Medical and dental resins, Jewelry resins, Ceramic resin)	5

5	**SLS 3D Printing Materials:** Nylon 12, Nylon 11, TPU, Nylon composites, structure, properties and applications.	5
6	Metal 3D Printing Materials: Structure, properties and applications of Titanium, Stainless steel, Aluminum, Tool steel, Nickel alloys,	5
7	**Powder materials:** Introduction and History of Powder Metallurgy (PM), Present and Future Trends of PM, Powder Production Techniques, Different Mechanical and Chemical methods, Atomization of Powder, other emerging processes, Performance Evaluation of different Processes, Design & Selection of Process. Microstructure Control in Powder, Powder Shaping, Ceramics Sintering, Sintering of Single & Mixed Phase Powder, Liquid Phase Sintering,	5

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	25	25	--	---

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books/Material:

1. Dongdong Gu, Laser Additive Manufacturing of High-Performance Materials, Springer, 2015.
2. G Odian Principles of Polymerization, Wiley Inerscience John Wiley and Sons, 4th edition, 2005.
3. Li Yang · Keng Hsu · Brian Baughman Donald Godfrey · Francisco Medina Mamballykalathil Menon · Soeren Wiener, Additive Manufacturing of Metals: The Technology, Materials, Design and Production, Springer, 2017.
4. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.
5. William D Callister Jr, David G Rethwisch,"Material Science and Engineering: An Introduction, 10th Edition

Course Outcomes:

At the end of the course, student should be able to:

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Understand the essential properties and characteristics of Different 3D Printing Material.	20
CO-2	Select additive manufacturing process for a given material and application.	30

CO-3	Analyse the polymerization processes and the significance for 3DP.	30
CO-4	Differentiate different 3D printing materials for future application	20