Course Title:	**ADDITIVE MANUFACTURING**	Semester	**I/II**
Course Code:	**BETCK105F /205F**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:0:0	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03

Course Learning Objectives

CLO1. To know the principle methods, areas of usage, possibilities and limitations of the Additive Manufacturing technologies.
CLO 2. To be familiar with AM process steps
CLO 3. To get exposed to process selection & software's used in AM
CLO 4. To know various post processing techniques.
CLO 5. To be familiar with the characteristics of the different materials which are used in Additive Manufacturing.

Teaching-Learning Process:

1. Conceptual Understanding: Through collaboration and discussions, the students' grasp of key ideas, their relationships, and how they apply them in different contexts is enhanced.
2. Developing Critical Thinking Abilities: Based on their understanding, students develop the ability to analyse information, evaluate arguments, and form independent judgments.
3. Activity based learning
4. PPT Presentation & Smart board Teaching

Module-1: Introduction to Additive Manufacturing (08 hours)

Self-study: Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling.

Introduction: Need for Additive Manufacturing, AM--Classification of AM processes- Benefits- Applications, distinction between - AM and CNC machining, AM & Rapid proto-typing, AM & Reverse engineering technology. milestones in AM development.

Applications: Modelling & Design industry

(RBT Levels: L1, L2 and L3)

Module-2: ADDITIVE MANUFACTURING PROCESS CHAIN (8 hours)

Self-study: Top down building process & bottom top building process.

INTRODUCTION: The eight steps in additive manufacture, variations from one AM machine to another, metal systems, maintenance of equipment, materials handling issues, design for AM, and application areas.

Applications: Manufacturing of laminates, Dentistry, Medical implants

(RBT Levels: L1, L2 and L3)

Module-3: Process Selection (08 hours)

Self-study: Powder Technology, sintering process, types of polymers

Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control.
Preparation of CAD models –Different software's used in AM for converting CAD model to STL file, STL file manipulation, Software issues for AdditiveManufacturing.

Applications: Jewelry industry, Design industry

(RBT Levels: L1, L2 and L3)

Module-4: Post Processing (08 hours)

Self-study: Methods to remove support materials,

INTRODUCTION: Support material removal, Types of support materials, surface texture improvements, preparation for use as a pattern, property enhancements using non-thermal techniques and thermal techniques. Overcoming the challenges of AM in enhancing the structural integrity of the components.

Applications: Casting industries to prepare patterns.

(RBT Levels: L1, L2 and L3)

Module-5 Additive Manufacturing-Multiple material (8 hours)

Self-study: Shape Deposition Manufacturing (SDM), Ballistic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting

The use of multiple materials in additive manufacturing: Introduction, multiple material approaches, discrete multiple material processes, porous multiple material processes, blended multiple material processes, commercial applications using multiple materials, future directions.

Applications: Aerospace, defence, automobile, Bio-medical and general engineering industries**.**

(RBT Levels: L1, L2 and L3)

Course outcome

At the end of the course the student will be able to:

CO1 : Recognize the development of AM technology and its propagation into various businesses and developing opportunities

CO2: Acquire knowledge on process of transforming a concept into the final product inAM technology.

CO3 : Familiar with the software's used in AM

CO4: Acquire knowledge of improving surface finish & its texture.

CO5: To know the multi-material processes for futuristic applications.

Course Assessment and Evaluation Details (both CIE and SEE)

Continuous Internal Evaluation: 50 marks		
Theory Assessment Tool	**Marks**	**Reduced marks**
IAT-1	25	25
IAT-2	25	
Assessment -1(activity based)	25	25
Assessment-2(activity based)	25	
Semester End Examination (SEE) : 50 marks		
SEE	**Marks**	**Reduced marks**
Course end examination (Answer any one question from each unit – Internal choice)	**100**	**50**

Activity-Based Learning / Practical Based learning :

1) Prepare/Demonstrate a model building using FDM process.
2) Prepare/Demonstrate a model building using SLA process.

Suggested Learning Resources:

Test Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Additive Manufacturing Technology, Hari Prasad, A.V.Suresh, Cengage,2019
2. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani Additive manufacturing technologies. 3rd edition Springer Cham, Switzerland. (2021).

Reference Books:

1) Rapid Prototyping: Principles and D.T. Pham, S.S. Dimov Springer 2001Applications in Manufacturing.
2) "Rapid Prototyping: Principles & Applications Chua Chee Kai, Leong Kah Fai World Scientific 2003.
3) Rapid Prototyping: Theory & Practice Ali K. Kamrani, Emand Abouel Nasr, Springer 2006.
4) Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing Andreas Hanser Publishers 2011 Gebhardt

Web links and Video Lectures (e-Resources):

- https://ewi.org/capabilities/additive-manufacturing/the-seven-processes-of-additive-manufacturing/
- https://www.youtube.com/watch?v=URUC6-nkLCM
- https://www.eos.info/about-us/what-we-do/additive-manufacturing

COs and POs Mapping (CO-PO mappings are only **Indicative)**

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	0	0	0	1	0	0	0	0	2	2
CO2	3	2	1	0	0	1	0	0	0	0	2	2
CO3	3	2	1	0	1	1	0	0	0	0	3	2
CO4	3	2	0	0	1	1	0	0	0	0	3	2
CO5	3	2	0	0	1	1	0	0	0	0	3	2

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped