Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum Structure and Syllabus
of
Honor in Additive Manufacturing
(Approved by BoS Mechanical Engineering)
(Course 2020)

Effective from Academic Year 2023-24

Institute Vision

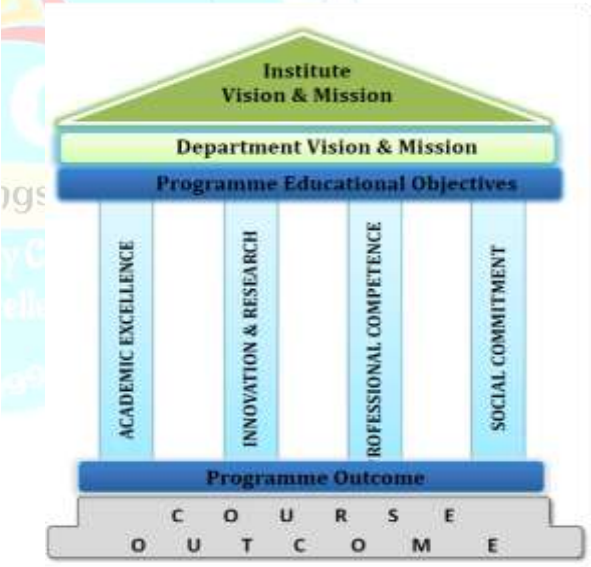
To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills and Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with ability to think and act independently in demanding situations.

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



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Preface

Looking at Global Scenario to enhance the employability skills and impart deep knowledge in emerging/ multidisciplinary areas, an additional avenue is provided to passionate learners through the Minors and Honors Degree Scheme in academic structure.

For Honors degree program, student has to earn additional 20 credits in emerging area of one's own domain.

Objectives of Honors Degree

- To enable students to pursue allied academic interest in contemporary areas.
- To provide effective yet flexible options for students to achieve basic to intermediate level competence in the contemporary area.
- To enhance the employability skills with different combinations of competencies and flavors.
- To provide an academic mechanism for fulfilling demand of specialized areas from industries for higher order skill jobs.
- To provide a strong foundation to students aiming to pursue research/ higher studies in the Contemporary field of study.

Preface of Honor in Additive Manufacturing

Additive Manufacturing (AM) is an emerging technology of manufacturing parts using a layer-by-layer approach. Additive Manufacturing is a viable alternative to traditional manufacturing, because of its capability to manufacture highly complex parts with great accuracy. Over the last two decades, the AM processes are evolving in technologies, applications, and productivity. The honor course in Additive Manufacturing is aimed to advance the fundamental understanding of additive manufacturing by studying the different processes and technologies.

Course Objectives:

- The major objective of this course is to acquaint students with the industry-relevant technologies of Additive Manufacturing including Polymer and Metal based AM.
- The course aims to provide knowledge of fundamental concepts used in Additive Manufacturing including, the selection of materials, characterization of additively manufactured parts, mathematical modelling of processes, and their applications in various fields.
- The course also aims to provide a hands-on acquaintance with the Polymer and Metal based AM technologies with relevant case studies have been included to introduce the students to the Design for Manufacturing (DFAM) to describe the AM process plan including part-building strategies, topology optimization and post-processing techniques.

Course Outcomes:

At the successful completion of this Honors course in Additive Manufacturing, students will be able to:

- Explore opportunities and career in Additive Manufacturing
- Make decisions in the design and development of parts manufactured through AM.
- Create CAD models for parts and demonstrate and identify the challenges in AM.
- Identify recent developments and gaps in AM techniques.

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LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

Sr. No.	Abbreviation	Full form of Abbreviation
1	L	Lecture
2	P	Practical
3	T	Tutorial
4	H	Hours
5	CR	Credits
6	IE1	Internal Evaluation 1
7	IE2	Internal Evaluation 2
8	MTE	Mid Term Examination
9	ETE	End Term Examination
10	OR	Oral
11	PR	Practical
12	PROJ	Project
13	S	Seminar

CREDIT DISTRIBUTION: SEMESTER WISE						
1 Lecture Hour = 1 Credit 2 Lab Hour = 1 Credit 1 Tutorial Hour = 1 Credit Seminar -1 Credit						
Sr. No.	**Course Title**	**Credits/Semester**				
		5	**6**	**7**	**8**	**Total**
1.	Polymer 3D Printing	4	0	0	0	4
2.	Polymer 3D Printing Lab	1	0	0	0	1
3.	Metal 3D printing	0	4	0	0	4
4.	Design for Additive Manufacturing	0	0	3	0	3
5.	Design for Manufacturing & Assembly Lab	0	0	1	0	1
6.	Seminar/Mooc/Experiential learning	0	0	2	0	2
7.	Integrated Project	0	0	0	5	5
		5	**4**	**6**	**5**	**20**

Curriculum structure

ADDITIVE MANUFACTURING

Honor in Mechanical Engineering

Curriculum structure

ADDITIVE MANUFACTURING

Honor in Mechanical Engineering

Semester	Course Code	Course Name	Teaching Scheme					Evaluation Scheme						
			L	P	T	H	CR	IE	MTE	ETE	TW	PR	OR	Total
V	HME5979	Polymer 3D printing	3	-	1	4	4	20	30	50	-	-	-	100
V	HME5980	Polymer 3D printing Lab	-	2	-	2	1	-	-	-	25	25	-	50
VI	HME6979	Metal 3D printing	3	-	1	4	4	20	30	50	25	-	-	125
VII	HME7978	Design for Additive Manufacturing	3	-	-	3	3	20	30	50	-	-	-	100
VII	HME7979	Design for Manufacturing & Assembly Lab	-	2	-	2	1	-	-	-	-	25	-	25
VII	HME7980	Seminar/MOOC/ Experiential learning	-	4	-	4	2	-	-	-	-	-	50	50
VIII	HME8980	Project	-	10	-	10	5	-	-	-	100	-	50	150
			9	18	2	29	**20**	60	90	150	150	50	100	**600**

Abbreviations: L-Lecture, P-Practical, T-Tutorial, H- Hours, IE- Internal Evaluation, MTE- Mid Term Evaluation, ETE- End Term Evaluation, TW –Termwork, PR-Practical, OR - Oral

Course Syllabus

ADDITIVE MANUFACTURING

Semester-V

Program:	Honor in Additive Manufacturing					Semester: V			
Course:	Polymer 3D Printing					Code: HME5979			
Teaching Scheme				Evaluation Scheme					
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	TW	PR	Total
3	1	4	4	20	30	50	-	-	100

Prior Knowledge of:

a. Polymer Materials,
b. Fundamentals of LASER……are essential

Course Objectives:

1. To understand the fundamentals of different polymer based additive manufacturing process.

Course Outcomes:

After learning the course, the learners will be able to,

1. Analyze the parameters affecting in Vat Photo polymerization Processes.
2. Analyze the parameters affecting in Material Jetting Processes.
3. Analyze the parameters affecting in Extrusion-Based polymer AM Processes.
4. Analyze the parameters affecting in Powder Bed Fusion polymer AM Processes.
5. Suggest post processing technique to finish the job.
6. Compare and select appropriate polymer based Additive manufacturing process for part under consideration.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Additive Manufacturing** Definitions, Geometric and Material Capabilities of Additive Manufacturing, Classification of Additive Manufacturing based on ASTM and Feed Stock Materials, Generic Additive Manufacturing Process, Other Related Technologies, Applications of Additive Manufacturing. **Introduction to Polymer 3D Printing** Polymer Additive Manufacturing Technology Landscape, Exciting Technological Developments in Polymer 3D Printing, Polymer 3D Printing Trends, Opportunities and Applications.	10
2.	**Liquid Additive Manufacturing** Introduction, Classification: Photo Polymerization and Rapid Freezing, Working Principle and Sub-systems, Stereolithography (SLA): Working Principle, Architecture of equipment, Subsystems, Laser Beam, Laser Curing Mechanisms, Galvanometer, Recoating System. **Other Liquid Additive Manufacturing Processes:** Digital Light Processing, Object Polyjet, Autostrade's E-Dart, Solid Ground Curing (SGC), Micro-stereolithography, Robotic – SLA, Other Processes.	10
3.	**Material Jetting AM Processes** Introduction, Working Principle, Architecture of Equipment, Materials, Process Parameters, Process Capabilities, Applications, Case Studies.	10
4.	**Extrusion-Based AM Processes** Fused Deposition Modelling (FDM)/ Fused Filament Fabrication (FFF): Introduction, Working Principle, Architecture of Equipment, Materials, Process Parameters and Modelling, Plotting and Path Control, Bio-Extrusion, Contour Crafting, Process Capabilities, Applications, Case Studies.	10
5.	**Powder Bed Fusion AM Processes** **Selective Laser Sintering (SLS):** Introduction, Working Principle, Architecture of Equipment, Materials, Powder Fusion Mechanism, Process parameters and Modelling, Powder Handling, Commercial Machines, Process Capabilities, Applications, Case Studies. **Multi Jet Fusion:** Introduction, Working Principle, Architecture of Equipment, Materials, Process parameters, Process Capabilities, Applications, Case Study.	10
6.	**Post-Processing in Polymer Additive Manufacturing** Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-Thermal and Thermal Techniques.	10
	Total	60

Text Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.

2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.

References Books:

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.

2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.

3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.

Online resources:

1. https://www.nist.gov/additive-manufacturing
2. https://www.metal-am.com/
3. http://additivemanufacturing.com/basics/
4. https://www.3dprintingindustry.com/
5. https://www.thingiverse.com/
6. https://reprap.org/wiki/RepRap

List of Assignments or Tasks

1. Assignment on modelling of liquid-based 3D manufacturing technologies.
2. Assignment on modelling of solid based 3D manufacturing technologies.
3. Assignment on modelling of powder-based 3D manufacturing technologies.

Program:	Honor in Additive Manufacturing			Semester : V			
Course:	Polymer 3D Printing Lab			Code : HME5980			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Hours	Credit	TW	PR	OR	Total
-	2	2	1	25	25	-	50

Prior Knowledge of:

a. Polymer Materials,
b. Fundamentals of LASER,
c. Basics of any CAD package……are essential

Course Objectives:

1. To design and print 3D polymer component.

Course Outcomes:

After learning the course, the learners will be able to,

1. Build geometric model of a given object using 3D modeling software.
2. Create and manipulate STL file as per the demand of object under printing.
3. Apply process algorithm.
4. Build any given polymer object by optimal utilization of available 3D printer.
5. Post-process the printed object and check its quality.

Detailed Syllabus: (24 Hours)

1. CAD Modelling for additive manufacturing.
2. STL file: Introduction, Data Structure, ASCII, Binary, Resolution, Tolerances, Manipulation of STL files.
3. Slicing Methods.
4. Tool Path Planning.
5. Introduction to 3D Printing Software, process parameters for Additive Manufacturing Technology (CURA, GRABCAD)
6. Printing polymer models using 3D printer.
7. Post processing of printed part and measurement of dimensional accuracy, surface quality and mechanical properties of printed model.
8. Industrial visit and report submission.

Course Syllabus

ADDITIVE MANUFACTURING

Semester-VI

Program:	Honor in Additive Manufacturing			Semester: VI				
Course:	Metal 3D Printing			Code: HME6979				
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	TW	Total
3	1	4	4	20	30	50	25	125

Prior Knowledge of:

a. Metals and alloys,
b. Metal Welding Processes,
c. Fundamentals of LASER,
d. Electric Arc,
e. Electron Beam.……are essential

Course Objectives:

1. To understand the different manufacturing process of metal based additive manufacturing process.

Course Outcomes:

After learning the course, the learners will be able to,

1. Understand the Additive manufacturing techniques used for metals.
2. Recognize the key parameters influencing metal based additive manufacturing techniques.
3. Identify advances in the metal additive manufacturing processes and scope for future applications.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Metal Additive Manufacturing (AM) Processes** Introduction, Classification based on ASTM and Feed Stock Materials, Applications, Metal Additive Manufacturing Technology Landscape Developments in Metal AM, Distinction between Additive Manufacturing, Casting, Forming and CNC Machining, Opportunities and Challenges in metal AM, Case Studies.	10
2.	**Powder Bed Fusion (PBF)** Introduction, Terms of references, Classification, Process Heads, Heat Sources, Feed Stock Materials. **Working Principle, Architecture of equipment, Process Parameters, Solidification, Microstructure and Defects, Capabilities of:** Direct Metal Laser Sintering (DMLS), Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Electron Beam Melting (EBM)	10
3.	**Directed Energy Deposition (DED)** Introduction, Terms of references, Classification, Process Heads, Heat Sources, Feed Stock Materials. **Working Principle, Architecture of equipment, Process Parameters, Solidification, Microstructure and Defects , Capabilities of:** Electron Beam-DED (EB-DED), Electric/Plasma Arc-DED (GMA/PA-DED), Laser-DED (L-DED) Powder Bed Fusion (PBF) Vs Directed Energy Deposition (DED)	10
4.	**Binder Jetting AM Processes** Working Principle, Architecture of Equipment, Process Parameters, Materials, Process Capabilities , Research Achievements in Printing Deposition, Technical Challenges in Printing, Applications, Case Studies. **Sheet Lamination AM Processes** Working Principle, Bonding Mechanisms, Architecture of equipment, Process Parameters**,** Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC Applications, Case Studies.	10
5.	**Post Processing for Metal AM** Introduction, Approaches: Single-Step and Multi-Step, Steps: Process Inherit, Mechanical Properties, Surface Treatments and Finishes, Categories: Stress Relief, Support Removal, Gluing and Welding of AM Parts, Heat Treatment, Surface Finishing, Coloring, Inspection, Quality Control, Characterization: X-ray diffraction (XRD), XRM, Field Emission Scanning Electron Microscope (FESEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Transmission electron microscopy (TEM), Introduction to Particle Size Characterization, Zeta potential measurement – Particle size analysis, specific surface area by BET analysis	10
6.	**Advances in Metal Additive Manufacturing** Composite 3D printing, Bio 3D printing of tissues and organs, 3D printing in space, Hybrid Additive Manufacturing, 4D printing, future applications of Metal AM. **Other Considerations in Metal Additive Manufacturing** Health and Safety, Material Exposure, Gas Monitoring, Gas Exhaust, Material Handling, Risk of explosion, AM Part Certification	10
	Total	60

Text Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.
2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.

References Books:

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.
3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.

Online resources:

1. https://www.nist.gov/additive-manufacturing
2. https://www.metal-am.com/
3. http://additivemanufacturing.com/basics/
4. https://www.3dprintingindustry.com/
5. https://www.thingiverse.com/
6. https://reprap.org/wiki/RepRap

List of Assignments or Task

1. Assignment on solid based 3D manufacturing technologies.
2. Assignment on liquid-based 3D manufacturing technologies.
3. Assignment on powder-based 3D manufacturing technologies.

Course Syllabus

ADDITIVE MANUFACTURING

Semester-VII

Program:	Honor in Additive Manufacturing					Semester: VII		
Course:	Design for Additive Manufacturing					Course code: HME7978		
Teaching Scheme				Evaluation Scheme				
Lecture	Practical	Hours	Credit	IE	MTE	ETE	PR	Total
3	-	3	3	20	30	50	-	100

Prior Knowledge of:

a. Fundamentals of LASER,
b. Electric Arc,
c. Electron Beam,
d. Generic Additive Manufacturing Process.……are essential

Course Objectives

1. Apply design for additive manufacturing guidelines in designing mass customized products

Course Outcomes

After learning the course, the learners will be able,

1. To identify the need of design for additive manufacturing.
2. Identify design and manufacturing constraints and choose appropriate polymer or metal AM process.
3. To understand and analyze the various parameters and tools involved in AM Processes.
4. To implement the concept of design for additive manufacturing.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Design for Additive Manufacturing (DfAM)** Introduction to Design for X, Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DFAM tools, Requirements of DFAM methods, General Guidelines for Designing AM Parts, Design to avoid Anisotropy, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post- Processing, Take Advantage of Design Complexity, Function First, Materials Second, Use Topology Optimization or Lattice Structures.	7
2.	**Computational Tools for Design Analysis and Optimization of AM Parts** Aims of Using Design Analysis for AM, Special Considerations for Analysis of AM Parts, Meshing, Boundary Conditions, Optimization, Topology Optimization, Parametric or Size Optimization, Build Process Simulation: Model Slicing, Contour Data Organization, Layer-by-Layer Simulation, Hatching Strategies, Scan Pattern Simulation and Tool Path Generation.	8
3.	**Design Guidelines for Part Consolidation** Design Guidelines for Part Consolidation: Design for Function, Material Considerations, Number of Fasteners, Knowledge of Conventional DFM/DFA, Assembly Considerations, Moving Parts	7
4.	**Design for Minimal Material Usage** Topology Optimization, Modelling of Design Space, Defining Design and Manufacturing Constraints, Performing Analysis for Weight Reduction, Maximize Stiffness, Minimize Displacement. **Design for Improved Functionality** Multi scale design for Additive manufacturing, Mass customization, Biomimetic, Generative design, Design of multi-materials and functionally graded materials.	8
5.	**Design for Polymer and Metal Additive Manufacturing** Anisotropy, Wall Thicknesses, Overhangs, Support Material, Accuracy, Tolerances, Layer Thickness, Resolution, Print Orientation, Warpage, Over Sintering, Circular Profiles, Hollowing Parts, Holes, Fillets, Ribs, Threads, Font Sizes and Small Details. Powder Morphology, Powder Size Distribution, Material Characteristics, Designing to Minimize Stress Concentrations, Residual Stress, Shrinkage.	7
6.	**Software and Controller in AM** Types of In-fill, Types of slicing, Software Integration (with Process, Slicing, etc), Control system (PLC and safety PLC, micro control/ Microcontroller, Micro-processor control), CAD Software and Controller Interfacing, CURA Software, Relevant G/M Codes, Standard firmware (Merlin Software, etc), In-process Monitoring, Calibration.	8
	Total	45

Text Books:

1. A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, and Damien Motte, Springer, 2020.
2. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015 2.
3. Amit Bandyopadhyay, Susmita Bose, "Additive manufacturing", CRC Press, Taylor & Francis Group, 2016 3.
4. Ian Gibson, David W. Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer, 2010

References Books:

1. Rupinder Singh J. Paulo Davim, "Additive Manufacturing - Applications and Innovations" CRC Press Taylor& Francis Group, 2019
2. I. Gibson, D. W. Rosen, B. Stucker, "Additive Manufacturing Technologies" Springer, 2010
3. L. Jyothish Kumar, Pulak M. Pandey, David Ian Wimpenny, "3D Printing and Additive Manufacturing Technologies" Springer, 2019.
4. Design for Advanced Manufacturing: Technologies and Process, Laroux K, Gillespie, McGrawHill, 2017.

Online resources:

1. https://www.nist.gov/additive-manufacturing
2. https://www.metal-am.com/
3. http://additivemanufacturing.com/basics/
4. https://www.3dprintingindustry.com/
5. https://www.thingiverse.com/
6. https://reprap.org/wiki/RepRap

Program:	Honor in Additive Manufacturing			Semester: VII			
Course:	Design for Manufacturing & Assembly Lab			Code: HME7979			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Hours	Credit	TW	OR	PR	Total
-	2	2	1	-	-	25	25

Prior Knowledge of:

a. Polymer Additive Manufacturing,
b. Metal Additive Manufacturing,
c. Basics of any CAD package.……are essential

Course Objectives:

1. To apply principles of DFMA for printing functional parts/components.

Course Outcomes:

After learning the course, the learners will be able,

1. To create aesthetic CAD models having market appeal, convert CAD model into STL file, manipulate STL file and apply process algorithm (slicing software) required to print functional three dimensional part.
2. To do topology optimization and built optimization.
3. To do process planning for additive manufacturing of a given part.
4. To print functional three dimensional parts/components.
5. Apply post processing techniques and do quality inspection of printed part.

Detailed Syllabus: (24 Hours)

Printing of functional part by applying principles of DFMA

1. Part/assembly modeling of any functional part/component using any CAD Package.
2. Generation of STL File, STL File Problems, STL File Manipulation (Materialize Magics, and NETFAB), Slicing
3. Tool-Path Planning.
4. Printing of functional part/component using 3D printer by applying principles of DFMA .
5. Post processing.
6. Measurement of dimensional accuracy, surface quality, microstructure, mechanical properties and functioning of printed model.

Program:	Honor in Additive Manufacturing					Semester: VII	
Course:	Seminar/Experiential learning/ MOOC course					Code:HME7980	
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Hours	Credit	IE	TW	OR	Total
-	4	4	2	-	-	50	50

Course Objectives:

1. Students will able to deliver the knowledge acquired on the various 3D printing technologies.
2. Students will identify the gaps and scope of the 3D printing technology within manufacturing industries.

Course Outcomes:

After learning the course, the learners will be able to,

1. Review and comprehend research literature and relevant data to additive manufacturing.
2. Collect, analyse and interpret data for appropriate design for additive manufacturing.
3. Prepare a technical report with appropriate summarization of topic under study.
4. Present the neat report.

Contents: Each student is expected to prepare seminar on Advances in 3D printing or undergo 48 hrs. of experiential learning or undergo relevant MOOC course.

Contents of the Seminar (48 Hours)

The contents of the seminar are expected to include the following:

- Abstract/Summary
- Introduction: Past and Present Developments, Market Trend, Methodology, Capabilities, Applications, Scope.
- Literature review: The review should be conducted from at least ten research papers publishedduring last five year.
- Case study
- References

Course Syllabus

ADDITIVE MANUFACTURING

Semester-VIII

Program:	Honor in Additive Manufacturing			Semester: VIII			
Course:	Project			Code: HME8980			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Hours	Credit	IE	TW	OR	Total
-	10	10	5	-	100	50	150

Prior knowledge of:

a Software used for Modelling of 3D printed parts

b. Processes for 3D printing of parts……are essential

Course Objectives:

Students are expected to study,

1. Design, build and analyse the 3D parts and processes manufactured using polymer or metal based additive manufacturing.
2. Activities associated within the project including, planning, execution, team work, management, etc. to deliver the project work.

Course Outcomes:

The students will be able to,

1. Define need, problem statement, objectives and expected results.
2. Design and develop a real-time application of additive manufacturing.
3. Prepare a technical report based on the project.
4. Present technical report based on the project work carried out.

Guidelines:

1. A group of 3 to 4 students needs to design and demonstrate the project under the guidance of the allocated guide.
2. Students can choose the project considering their implementation in Major Project.
3. The hardware implementation and or software simulation is compulsory.
4. Project Report should be submitted in compliance with term work associated with the subject.
5. Paper publication associated with the project as research outcome is appreciable.
6. Project work preferably should be completed in the laboratory/ industry.

Detailed Syllabus

Sr. No.	Activity	Duration (H)
1	Semester VIII (week 1 & 2): Project guide allotment, Finalization of topic and platform, Planning of the work, Literature review, identifying a problem, andformulating the problem for the project	20
2	Semester VIII (week 3 & 4): Methodology finalization, finalizing project proposal, Review 1 for finalization of topic and specification.	20
3	Semester VIII (week 5 & 6): Simulation of Ideas on appropriate software tools and finalization of hardware platform	20
4	Semester VIII (week 7 & 8): Understanding platform implementation and related software flow and execute the block-level design, Review 2 to understand the progress of the project	20
5	Semester VIII (week 9 & 10): Project Report writing and publication or copyright planning and execution.	20
6	Semester VIII (week 11 & 12): Demonstration of Project work and Final Review for submission and term work compliances.	20
	Total	120