LOK JAGRUTI UNIVERSITY (LJU)

L J INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering

Master of Engineering (M. E) - Semester – I

Course Code:	49050103
Course Name:	Rapid Prototyping Methods
Category of Course:	Core
Prerequisite Course:	UG level course in Manufacturing

Teaching Scheme				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
3	0	2	4	40

Course Objectives	
1	To provide the students with an understanding of the basic fundamentals of rapid prototyping.
2	To study the fabrication techniques and materials used in rapid prototyping.
3	To study various areas of defects and improvements in rapid prototyping.
4	To operate the rapid prototyping machines and workstations.

Syllabus			
Unit No.	Topic	Prerequisite Topic	Teaching Hours
01	**Introduction** 1.1 Classification of manufacturing processes, Different manufacturing systems 1.2 Introduction to Rapid Prototyping (RP) 1.3 Need of RP in context of batch production, FMS and CIM and its application 1.4 Basic Principles of RP, Steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP	---	**04 (10%)**
02	**Classifications of Different RP Techniques** 2.1 Based on raw material 2.2 Based on layering technique (2D or 3D) 2.3 Based on energy sources	---	**04 (10%)**
03	**Process Technology in RP** 3.1 Comparative study of various methods of RP 3.2 Stereo-lithography with photopolymerization 3.3 Fused-deposition modeling 3.4 Selective laser sintering, Selective laser melting 3.5 Laminated-object manufacturing 3.6 Ballistic particle Manufacturing 3.7 Solid base curing, Direct manufacturing & rapid tooling	---	**04 (10%)**
04	**CAD Data and Programming Techniques for RP** 4.1 Transformations, Solid modeling for RP, Surface modeling 4.2 STL file generation, Defects in STL files and repairing algorithms 4.3 Interface formats & Slicing methods 4.4 Design of support structures, Internal hatching and surface skin fills	---	**04 (10%)**
05	**Materials for RP** 5.1 Materials used for different RP processes 5.2 Selection criterions for materials for different processes 5.3 The advantages and limitations of different types of materials.	---	**04 (10%)**
06	**Reverse Engineering** 6.1 Introduction to reverse engineering 6.2 Integration of reverse engineering with rapid prototyping	---	**04 (10%)**
07	**Rapid Tooling** 7.1 Introduction to RT 7.2 Indirect & Direct Methods of RT 7.3 Sheet-Metal Forming by RT	---	**04 (10%)**
08	**Medical Applications in Rapid Prototyping** 8.1 Medical Applications of RP 8.2 Types of Medical Imaging, Software for Making Medical Models 8.3 Medical Materials, Other Applications	---	**04 (10%)**
09	**Introduction to NetFabb** 9.1 Toolset for design and implementation for additive manufacturing. 9.2 Streamline workflows and automate processes around 3D print preparation 9.3 Case Study	---	**04 (10%)**
10	**Generative Design** 10.1 Introduction to GD 10.2 Industrial Applications of GD 10.3 Case Study	---	**04 (10%)**

Course Outcome	
1	Able to understand virtual prototyping and testing of technology.
2	Able to understand the importance of Physical Prototyping.
3	Able to understand Rapid Manufacturing technologies and Synergic Integration Technologies in the present technological era.

Suggested Reference Books	
1	Rapid Product Development- Synergic integration of time-compression technologies K. P. Karunakaran, V. P. Bapat, Sreenath Babu Akula P. D. Solanki Gaurav Gupta, V.R. Prasanth, Saket Anand, Arnab Sarkar and S. Venkatkrishnan
2	Manufacturing Processes for Engineering Materials Serope Kalpakjion and Steven R. SchmidPearson Education
3	Rapid Prototyping: Principles and Applications (Third Edition), Chee Kai Chua, Kah Fai Leong, Chu Sing Lim
4	Rapid Prototyping and Engineering Applications – A Toolbox for Prototype Development, Second Edition, Fuewen Frank Liou
5	Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Andreas Gebhardt, Jan-Steffen Hötter
6	Additive Manufacturing Technologies 3rd ed. 2021 Edition, Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani
7	Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Andreas Gebhardt, Hanser Publishers, 2011.

Proposed Evaluation Scheme by Academicians (Percentage of Weightage out of 100%)

Theory Descriptive Test		MCQ Test		Hands on Project	
Formulas and Derivation Test		**Numerical Test**		**Seminar**	

Practical Project/Hands On Project

Sr. No.	List of Practical Projects	Linked with Unit
1	Hands on Slicing Software FDM	Unit 3
2	Hands on Slicing Software SLS / DMLS	Unit 3
3	Hands on Lattice Software	Unit 6
4	Hands on Fused Deposition Modeling (FDM) / Fused Filament Fabrication (FFF)	Unit 6
5	Hands on Direct Metal Laser Sintering (DMLS)	Unit 6
6	Hands on Design for Additive Manufacturing	Unit 2
7	Hands on Latticing for Additive Manufacturing	Unit 9
8	Hands on Generative Design	Unit 10

List of Recommended MOOC Courses:

1) https://www.coursera.org/learn/generative-design-additive-manufacturing
2) https://www.coursera.org/learn/generative-design-industrial-applications
3) https://www.coursera.org/specializations/3d-printing-additive-manufacturing
4) https://www.coursera.org/learn/additive-manufacturing-3d-printing
5) https://www.coursera.org/learn/generative-design-additive-manufacturing

List of Recommended Certifications:

1) https://www.autodesk.com/certification/all-certifications/design-manufacturing-professional
2) https://www.autodesk.com/certification/all-certifications/generative-design-manufacturing-expert

List of Recommended Software:

1) **Autodesk Fusion 360 (CAM)**
2) **Autodesk NetFabb Ultimate**
3) **TikerCAD**
4) **Ultimaker Cura**
5) **Slic3r**