Subject Code: 01CA0305

Subject Name: Rapid Prototyping and Tooling

M.Tech. II Year – (Sem-4) CAD/CAM

Type of course: Program Elective

Prerequisite: NA

Rationale: - In present era it is highly essential to be able to prepare final product or its prototypes at the earliest. This is desirable to ensure that all the expected requirement of product is addressed and if required, its performance is also assessed from the prototype. Rapid prototyping offers a convenient option for manufacturing of product or its prototype from the CAD model

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Evaluation Scheme					Total Marks
				Theory Marks			Practical Marks		
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
4	---	2	5	50	30	20	25	25	150

Course outcome
On completion of this course students will be able to:

1. Understand and use techniques for processing of CAD models for rapid prototyping.
2. Understand and apply fundamentals of rapid prototyping techniques.
3. Use appropriate tooling for rapid prototyping process.
4. Use rapid prototyping techniques for reverse engineering.

Sr. No	Topic	Lectures	Weight age
1	**Introduction:** Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.	3	5%
2	**CAD Modeling and Data Processing for RP:** CAD model preparation, Data Requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.	6	15%

3	**RP Systems:** **Photopolymerizatin** Stereo lithography (SL), SL resin curing process, SL scan patterns, Microstereolithography, Applications of Photo polymerization Processes. **Powder Bed Fusion:** Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed Fusion Processes. **Extrusion-Based RP Systems:** Fused Deposition Modeling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes. **3D Printing :** 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modeling, Applications of Printing Processes. **Sheet Lamination :** Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. **Beam Deposition:** Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks.	**20**	**45%**
4	**Rapid Tooling:** Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.	**04**	**10%**
5	**Reverse Engineering:** Basic concept, Digitization techniques, Model Reconstruction, Data Processing for Rapid Prototyping, Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development.	**05**	**15%**
6	**Errors in RP Processes:** Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.	**03**	**5%**
7	**RP Applications:** Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.	**02**	**5%**

Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level	C Level
10	10	20	15	25	20

Legends: R: Remembrance**; U:** Understanding**; A:** Application, **N:** Analyze**,** and **E:** Evaluate

References:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.

2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press.
5. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
6. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer,

List of Experiments:

1. Review of CAD Modeling Techniques and Introduction to RP
2. Generating STL files from the CAD Models & Working on STL files
3. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
4. Simulation in Catalyst Software
5. Fabricating the physical part on a RP machine
6. Learning techniques for fabricating an assembly
7. Prepare a CAD model with complex geometry and study effect of slicing parameters on final product manufactured through R