GOVERNMENT OF GUJARAT

LUKHDHIRJI ENGINEERING COLLEGE, MORBI

Mechanical Engineering Department

Course Teaching-Learning-Evaluation Strategy

Subject: Rapid Prototyping (3171926) Academic Year: 2023-24(ODD)
Class: 7th Semester Type of course: Professional Elective
Faculties: H N Jani (HNJ), M B Vaghela (MBV) Prerequisite: Nil

Course Outcomes (Cos)

CO Nos.	CO statement	Weightage (Marks %)
1.	Distinguish RP and other related technology	10
2.	Understand and use techniques for processing of CAD models for rapid prototyping.	35
3.	Apply fundamentals of rapid prototyping techniques.	25
4.	Use appropriate tooling for rapid prototyping process.	20
5.	Create component with RP applications	10

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)	
3	0	2	4	70	30	30	20	150

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Recall	Understanding	Application	Analysis	Evaluate	Create
Marks % weightage	15	15	25	20	15	10
70 marks	10.5	10.5	17.5	14	10.5	7
30 marks	4.5	4.5	7.5	6	4.5	3

Course Evaluation Plan

	Direct Assessment				
	Internal Evaluation			External(Uni.) Evaluation	
	Mid Sem Exam (continue evaluation) (Theory)	Assignment/ Quiz	Lab. Work	Practical/ Viva (**IF)**	Uni. Exam (Theory)
Max. Marks	30	20	20	30	70
Weightage	30%			70%	
CO1	03	04	02		
CO2	11	07	06		
CO3	10	05	06		
CO4	06	04	03		
CO5	-	-	03		

Course Content with lecture plan:

Sr. No.	Chapter	Course outcome(s)	Lecture(s) require	Faculty
1	Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process. Distinction between RP and CNC, other related technologies.	CO1	04	MBV
2	CAD Modelling and Data Processing for RP: CAD model preparation, Data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.	CO2	12	MBV
3	RP Processes: Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photopolymerization (Stereolithography (SL), Microstereolithography), Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), Extrusion-Based RP Systems (Fused Deposition Modelling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)).	CO3,CO4	22	HNJ/ MBV
4	Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.	CO3	04	MBV
5	RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.	CO5	03	MBV

Reference Books:

1. 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. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
5. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer,

Course articulation matrix correlation

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2			3		3								3	3
CO3					3								3	3
CO4			2		3								3	3
CO5			2	2	3								3	3

Justification(s) of correlation between Co and Pos/PSOs

Mapping	Justification(s)
CO1 with PO1 (3)	CO1 mapped with PO1 because through CO1 students shows ability to apply basic engineering knowledge and fundamentals.
CO2 with PO3(3), PO5(3) PSO1(3),PSO2(3)	CO2 mapped with PO3, PO5, POS1 and PSO2 because students analyse and developing model with use of modern tools.
CO3 with PO5(3), PSO1(3), PSO2(3)	CO3 mapped with PO5, POS1 and PSO2 because students will use modern tools.
CO4 with PO3(2), PO5(3) PSO1(3),PSO2(3)	CO4 mapped with PO3, PO5, POS1 and PSO2 because students analyse and developing model with use of modern tools.
CO5 with PO3(2), PO4(2), PO5(3) PSO1(3), PSO2(3)	CO5 mapped with PO3, PO4, PO5, POS1 and PSO2because students demonstrate ability for design and development via interpretation/synthesis using modern tools.

Tagging of Cos with POs, PSOs, Cognitive Level (R-Remember, U-Understand, Ap- Apply, An-Analyse, E-Evaluate and C-Create), Knowledge Categories (F—Factual, C—Conceptual, P—Procedural and M—Metacognitive).

CO No.	Statement	POs	PSOs	Cognitive Level	Knowledge Categories
CO1	Distinguish RP and other related technology	PO1	-	U	C
CO2	Understand and use techniques for processing of CAD models for rapid prototyping.	PO3, PO5	PSO1, PSO2	Ap,An	C, P
CO3	Apply fundamentals of rapid prototyping techniques.	PO5	PSO1, PSO2	Ap,An	C, P
CO4	Use appropriate tooling for rapid prototyping process.	PO3, PO5	PSO1, PSO2	Ap	C, P
CO5	Create component with RP applications	PO3, PO4, PO5	PSO1, PSO2	C	C, P

List of Experiments:

Sr. No.	Title	COs	POs	PSOs	Marks
1	Review of CAD modeling technique and Introduction to Rapid prototyping	CO1	PO1	-	2
2	Generating STL files from the CAD models & Working on STL files.	CO2	PO3, PO5	PSO1, PSO2	3
3	Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)	CO2	PO3, PO5	PSO1, PSO2	3
4	Simulation in Catalyst Software	CO3	PO5	PSO1, PSO2	3
5	Fabrication the physical part on a RP machine	CO3	PO5	PSO1, PSO2	3
6	Learning techniques for fabricating an assembly.	CO4	PO3, PO5	PSO1, PSO2	3
7	Prepare a CAD model with complex geometry and Study effect of slicing parameters on final product manufactured through RP.	CO5	PO3, PO4, PO5	PSO1, PSO2	3

List of Experiments on virtual Lab:

Sr. No.	Title	Link	COs	POs	PSOs
1	FDM Anatomy of 3D Printer Machine	https://3dp-dei.vlabs.ac.in/exp/simulation-anatomy-fdm/	CO3	PO5	PSO1, PSO2
2	Cartesian 3D Printer Machine	https://3dp-dei.vlabs.ac.in/exp/simulation-cartesian-system/	CO3	PO5	PSO1, PSO2
3	Polar 3D Printing machine	https://3dp-dei.vlabs.ac.in/exp/simulation-of-polar-machine/	CO3	PO5	PSO1, PSO2
4	Delta 3D Printing machine	https://3dp-dei.vlabs.ac.in/exp/simulation-	CO3	PO5	PSO1,

		of-delta-machine/			PSO2
5	Simulation of Stereolithography Process	https://3dp-dei.vlabs.ac.in/exp/simulation-stereolithography-process/	CO3	PO5	PSO1, PSO2
6	Simulation of Fused Deposition Modelling (FDM) Process	https://3dp-dei.vlabs.ac.in/exp/simulation-modelling-process/index.html	CO3	PO5	PSO1, PSO2
7	Simulation of Selective Laser Sintering (Non-Metal) Process	https://3dp-dei.vlabs.ac.in/exp/simulation-laser-sintering-nonmetal/	CO3	PO5	PSO1, PSO2
8	Simulation of Selective Laser Sintering (Metal) Process	https://3dp-dei.vlabs.ac.in/exp/simulation-laser-sintering-metal/	CO3	PO5	PSO1, PSO2
9	Simulation of Laminated object manufacturing Process	https://3dp-dei.vlabs.ac.in/exp/simulation-laminated-object/	CO3	PO5	PSO1, PSO2
10	Simulation of Powder Binding / Jetting Process	https://3dp-dei.vlabs.ac.in/exp/simulation-powder-binding/	CO3	PO5	PSO1, PSO2

Online Links:

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://www.youtube.com/watch?v=KJj8CfnC0Ek
3. https://www.youtube.com/watch?v=S6P7fOwV04Q
4. https://nptel.ac.in/courses/112/107/112107078/

Software:

1. Catalyst software

Journals referred:

1. DOI: 10.17729/ebis.2018.1/3
2. DOI 10.1108/RPJ-11-2012-0101
3. DOI: 10.18535/ijsrm/v5i1.07