



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

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JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

Name of Subject: Additive Manufacturing [AM]

Subject Code: 8ME5-13

Year: 4th Year, VIIIth-Semester



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Department of Mechanical Engineering

Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for outcome based technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society.

Mission:

M1: To impart quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute relationship.



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Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1: To equip graduates with a strong foundation in engineering sciences, with an emphasis on mechanical engineering principles, enabling them to analyze, design, and solve real-world engineering challenges.

PEO2: To prepare graduates with sound scientific and engineering fundamentals to innovate and deliver effective solutions addressing practical challenges in mechanical engineering

PEO3: To inculcate in graduates a professional and ethical attitude, effective communication and teamwork skills, a multidisciplinary approach, entrepreneurial mindset, and the ability to connect engineering solutions with societal and environmental concerns.

PEO4: To provide students with an academic environment that fosters excellence, leadership, adherence to ethical standards, and encourages self-motivated lifelong learning essential for a successful professional career in mechanical

PEO5: To prepare students to excel in industry and higher education by providing quality education grounded in strong technical knowledge and high moral values

Program Specific Outcomes (PSOs)

PSO1: Graduates will be able to design, analyze, and fabricate electric and hybrid vehicles using modern engineering tools and sustainable practices.

PSO2: Graduates will be able to apply design principles and computational techniques, including programming and data structures, to analyze and solve mechanical engineering problems.



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Program Outcomes (POs)

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



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Department of Mechanical Engineering

SYLLABUS



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Scheme & Syllabus

IV Year- VII & VIII Semester: B. Tech. (Mechanical Engineering)

SME5-13: ADDITIVE MANUFACTURING

Credit: 3

3L+0T+0P

Max. Marks: 100(IA:30, ETE:70)

End Term Exam: 3 Hours

SN	Contents	Hours
1.	Introduction: Objective, scope and outcome of the course.	1
2.	Overview of Rapid Product Development (RPD): Need for the compression in product development, history of RP systems, Definition of RPD; Components of RPD. Rapid Prototyping (RP); Principle of RP; Technologies and their classifications.	2
3.	Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application	2
4.	Selective Laser Sintering& Fusion Deposition Modelling: Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.	4
5.	Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.	4
6.	Selection of RP process; Issues in RP; Emerging trends.	2
7.	Rapid Tooling (RT): Introduction to RT, Indirect RT process- Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Cast kirksite, 3Q keltool, etc.	3
8.	Direct RT processes: Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting),	3
9.	Emerging Trends in RT, Reverse Engineering: Geometric data acquisition, 3D reconstruction, Applications and Case Studies, Engineering applications, Medical applications.	3
10.	Processing Polyhedral Data: Polyhedral B-Rep modeling, STL format, Defects and repair of STL files,	2
11.	Introduction to software for RP : Brief overview of Solid view, magics etc.	2
TOTAL		40

Office of Dean Academic Affairs
Rajasthan Technical University, Kota



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REFERENCE BOOKS (MSE)



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Scheme & Syllabus

IV Year- VII & VIII Semester: B. Tech. (Mechanical Engineering)

TEXT BOOK	
1.	Rapid Prototyping: Principles and Applications, Volume 1 by Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, World Scientific.
REFERENCE BOOKS	
1.	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Brent Stucker, David W. Rosen, and Ian Gibson, Springer
2.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Gibson, Ian, Rosen, David, Stucker, Brent, Pearson.
3.	Rapid Prototyping: Principles and Applications in Manufacturing Noorani R, John Wiley & Sons.
4.	Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W. L., Liou F. W., CRC Press.
5.	Rapid Prototyping: Theory and practice, Kamrani A. K., Nasr E.A., Springer.



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COURSE OUTCOME

Subject: Additive Manufacturing [8ME5-13]

CO1: Describe the fundamental principles, history, and classifications of additive manufacturing processes.

CO2: Explain different AM technologies, materials, and process parameters, and compare them with conventional manufacturing methods.

CO3: Apply knowledge of AM processes to prepare CAD models, slicing, and pre-processing steps required for part fabrication.

CO4: Analyze the influence of design considerations, material selection, and process parameters on the quality and performance of AM parts.

CO5: Explain and differentiate between indirect and direct Rapid Tooling (RT) techniques, including their principles, materials, and applications in product development.

CO6: Apply the concepts of Reverse Engineering (RE), and software tools for geometric reconstruction and analyze case studies.

CO-PO MAPPING

Subject: Additive Manufacturing [8ME5-13]

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1	1	2	2	1	1	2	2
CO2	3	3	3	2	2	2	1	2	2	2	2	3	3
CO3	3	3	3	3	2	2	2	2	2	2	2	3	3
CO4	3	3	3	3	2	2	2	2	2	3	2	3	3
CO5	3	3	3	3	2	2	2	3	3	2	2	3	3
CO6	3	3	3	3	2	2	2	3	3	2	2	3	3



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Course Plan

Name of the Course : **Additive Manufacturing**

Code of the course : **8ME5-13**

Name of Faculty : **Mr. Yogesh Dubey**

Course Outcome

CO1: Describe the fundamental principles, history, and classifications of additive manufacturing processes.

CO2: Explain different AM technologies, materials, and process parameters, and compare them with conventional manufacturing methods.

CO3: Apply knowledge of AM processes to prepare CAD models, slicing, and pre-processing steps required for part fabrication.

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CO5: Explain and differentiate between indirect and direct Rapid Tooling (RT) techniques, including their principles, materials, and applications in product development.

CO6: Apply the concepts of Reverse Engineering (RE), and software tools for geometric reconstruction and analyze case studies.

Unit No.	Topic	LecNo	CO	Specific Objectives	Expected Outcomes	Primary Reference (Fundamentals of Modern Manufacturing : Materials, Processes, and Systems – Mikell P. Groover, 7th Edition, John Wiley & Sons, 2023)	
Intr o	Introduction & Course Overview	1	CO 1	Understand Introduction & Course Overview.	Explain Introduction & Course Overview.	Ch.01	Page 01-24
1	Need of RPD	2	CO 1	Understand Need of RPD.	Explain Need of RPD.	Ch.33	Page 786-787
	History of RP	3	CO 1	Understand History of RP.	Explain History of RP.	Ch.33	Page 788-789



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	Definition & Components of RPD	4	CO 1	Understand Definition & Components of RPD.	Explain Definition & Components of RPD.	Ch.33	Page 789-790
	Principle of RP	5	CO 1	Understand Principle of RP.	Explain Principle of RP.	Ch.33	Page 790-791
	RP Technologies	6	CO 1	Understand RP Technologies.	Explain RP Technologies.	Ch.33	Page 791-798
	SLA Principle	7	CO 1	Understand SLA Principle.	Explain SLA Principle.	Ch.33	Page 789
	SLA Process Parameters	8	CO 2	Understand SLA Process Parameters.	Explain SLA Process Parameters.	Ch.33	Page 789
2	SLA Data Preparation	9	CO 2	Understand SLA Data Preparation.	Explain SLA Data Preparation.	Ch.33	Page 790
	SLA Applications	10	CO 2	Understand SLA Applications.	Explain SLA Applications.	Ch.33	Page 790
	SLS Principle	11	CO 2	Understand SLS Principle.	Explain SLS Principle.	Ch.33	Page 791
	SLS Machine & Parameters	12	CO 2	Understand SLS Machine & Parameters.	Explain SLS Machine & Parameters.	Ch.33	Page 791
	SLS Applications	13	CO 2	Understand SLS Applications.	Explain SLS Applications.	Ch.33	Page 792
	FDM Principle	14	CO 2	Understand FDM Principle.	Explain FDM Principle.	Ch.34	Page 812-813
	FDM Process	15	CO 3	Understand FDM Process.	Explain FDM Process.	Ch.34	Page 814-816
	FDM Applications	16	CO 3	Understand FDM Applications.	Explain FDM Applications.	Ch.34	Page 816-817
3	Solid Ground Curing	17	CO 3	Understand Solid Ground Curing.	Explain Solid Ground Curing.	Ch.34	Page 817-818
	LOM Principle	18	CO 3	Understand LOM Principle.	Explain LOM Principle.	Ch.33	Page 793
	LOM Applications	19	CO 3	Understand LOM Applications.	Explain LOM Applications.	Ch.33	Page 794



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	Selection of RP Process	20	CO 3	Understand Selection of RP Process.	Explain Selection of RP Process.	Ch.33	Page 788
	Issues in RP	21	CO 3	Understand Issues in RP.	Explain Issues in RP.	Ch.33	Page 789
	Emerging Trends	22	CO 4	Understand Emerging Trends.	Explain Emerging Trends.	Ch.33	Page 796
	Rapid Tooling Intro	23	CO 4	Understand Rapid Tooling Intro.	Explain Rapid Tooling Intro.	Ch.33	Page 789
	Indirect RT	24	CO 4	Understand Indirect RT.	Explain Indirect RT.	Ch.33	Page 789
4	Silicon Rubber Molding	25	CO 4	Understand Silicon Rubber Molding.	Explain Silicon Rubber Molding.	Ch.33	Page 796
	Epoxy Tooling	26	CO 4	Understand Epoxy Tooling.	Explain Epoxy Tooling.	Ch.08	Page 182-185
	Spray Metal Tooling	27	CO 4	Understand Spray Metal Tooling.	Explain Spray Metal Tooling.	Ch.09	Page 197-198
	Investment Casting	28	CO 4	Understand Investment Casting.	Explain Investment Casting.	Ch.11	Page 233
	Direct RT	29	CO 5	Understand Direct RT.	Explain Direct RT.	Ch.33	Page 788
	Powder Metallurgy RT	30	CO 5	Understand Powder Metallurgy RT.	Explain Powder Metallurgy RT.	Ch.33	Page 789
	Welding Based RT	31	CO 5	Understand Welding Based RT.	Explain Welding Based RT.	Ch.33	Page 789
	Direct Pattern Making	32	CO 5	Understand Direct Pattern Making.	Explain Direct Pattern Making.	Ch.33	Page 791
5	Reverse Engineering Intro	33	CO 6	Understand Reverse Engineering Intro.	Explain Reverse Engineering Intro.	Ch.33	Page 796
	3D Data Acquisition	34	CO 6	Understand 3D Data Acquisition.	Explain 3D Data Acquisition.	Ch.33	Page 797



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	3D Reconstruction	35	CO 6	Understand 3D Reconstruction.	Explain 3D Reconstruction.	Ch.33	Page 797
	RE Applications	36	CO 6	Understand RE Applications.	Explain RE Applications.	Ch.34	Page 800
	STL Format	37	CO 6	Understand STL Format.	Explain STL Format.	Ch.34	Page 801
	STL Defects & Repair	38	CO 6	Understand STL Defects & Repair.	Explain STL Defects & Repair.	Ch.34	Page 803
	RP Software (Magics/SolidView)	39	CO 6	Understand RP Software (Magics/SolidView).	Explain RP Software (Magics/SolidView).	Ch.34	Page 805
	RTU Previous Questions	40	CO 6	Understand RTU Previous Questions.	Explain RTU Previous Questions.		

REFERENCE BOOKS

S. No.	Reference Book	Edition	Publisher	Year
1	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing – Ian Gibson, David W. Rosen & Brent Stucker	3rd Edition	Springer	2021
2	Rapid Prototyping: Principles and Applications – Chua Chee Kai, Leong Kah Fai & Lim Chu Sing	3rd Edition	World Scientific Publishing	2010
3	Rapid Manufacturing: An Industrial Revolution for the Digital Age – Neil Hopkinson, Richard Hague & Philip Dickens (Editors)	1st Edition	John Wiley & Sons	2006
4	Additive Manufacturing Technologies – Andreas Gebhardt & Jan-Steffen Hötter	2nd Edition	Hanser Publications	2016
5	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems – Mikell P. Groover	7th Edition	John Wiley & Sons	2023