

RENCANA PEMBELAJARAN SEMESTER (RPS)
TEKNOLOGI MANUFAKTUR ADITIF BERKINERJA TINGGI



Oleh:
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UNIVERSITAS MUHAMMADIYAH SURAKARTA

2025.2



UNIVERSITAS MUHAMMADIYAH SURAKARTA
PROGRAM STUDI DOKTOR TEKNIK MESIN

**FM-UMS-AA-FPU-PPK-02/
R0**

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH (MK)		KODE	Rumpun MK	Bobot (sks)		SEMESTER	Tgl Penyusunan
Teknologi Manufaktur Aditif Berkinerja Tinggi		DTM3231320	Manufaktur	T=3	P=0	pilihan	2025
OTORISASI		Pengembang RPS	Koordinator RMK			Ketua Program Studi	
		Prof. Agus Dwi Anggono, S.T., M.Eng., Ph.D	Prof. Agus Dwi Anggono, S.T., M.Eng., Ph.D			Prof. Ir. Waluyo Adi Siswanto, M.Sc., Ph.D	
Programme Learning (PL)	PLO-Prodi yang dibebankan pada MK						
	PLO8	Melakukan rekayasa teknologi dan pengembangan sistem, proses dan komponen otomotif manufaktur berbasis kemajuan teknologi terkini dengan mengoptimalkan sumber daya yang tersedia dan memperhitungkan batasan yang ada.					
	PLO9	Merencanakan penelitian yang berkontribusi pada keilmuan bidang otomotif manufaktur secara komprehensif dengan mengikuti perkembangan teknologi					
	PLO10	Melaksanakan penelitian yang bermanfaat bagi masyarakat atau industri, mengacu pada hasil riset yang teruji dengan mempertimbangkan efisiensi dan nilai tambah serta menggunakan piranti terkini dan modern.					
	Course Learning Outcomes (CLO)						
	CLO 1	Mengevaluasi penerapan teknologi komputasi bidang CAD/CAM/CAE yang berkaitan dengan rekayasa produksi rapid prototyping. (C5, PLO 8)					PLO8,
	CLO 2	Merancang prototype dengan teknik rapid prototyping. (C6, PLO 9)					PLO9,
	CLO 3	Mendesain prototype pada sebuah produk komponen kendaraan berbasis rapid pototyping (C6, PLO 10)					PLO10,
	Kemampuan akhir tiap tahapan belajar (Sub-CLO)						
	Sub-CLO 1	Teknologi komputasi bidang CAD/CAM/CAE yang berkaitan dengan rekayasa produksi rapid prototyping					CLO 1
	Sub-CLO 2	Merancang prototype dengan teknik rapid prototyping					CLO 2
	Sub-CLO 3	Mendesain prototype pada sebuah produk komponen kendaraan berbasis rapid pototyping					CLO 3
Deskripsi Singkat MK	Mata kuliah ini membahas secara mendalam berbagai aspek teknologi manufaktur aditif (additive manufacturing/AM) yang berfokus pada performa tinggi dan aplikasi tingkat lanjut. Materi diawali dengan landasan teoritis tentang proses manufaktur berbasis pelapisan (layered manufacturing) sebagai metode utama dalam pembuatan prototipe cepat (rapid prototyping). Selanjutnya, mahasiswa akan mempelajari berbagai teknologi dan metode dalam manufaktur aditif, mencakup proses fusi selektif (selective laser melting), sintering, stereolitografi, serta material yang digunakan, baik logam maupun polimer. Pembahasan juga mencakup sistem pendukung seperti perangkat lunak desain dan slicing, pengecoran vakum dan investasi, pelapisan permukaan, infiltrasi material, serta integrasi sistem produksi. Berbagai aplikasi teknologi ini akan dikaji, termasuk dalam bidang mikro-manufaktur, rekayasa biomedis, dan industri kedirgantaraan, dengan penekanan pada peningkatan presisi, kekuatan material, dan efisiensi energi. Mahasiswa diharapkan mampu mengevaluasi dan mengembangkan solusi manufaktur aditif yang inovatif dan berdaya saing tinggi untuk kebutuhan industri masa depan.						
Bahan Kajian: Materi Pembelajaran	Materi perkuliahan ini meliputi: 1 Pendahuluan dan prinsip dasar (Introduction and Basic Principles) 1.1 Pengertian Additive Manufacturing 1.2 Komponen peralatan pada AM 1.3 Mekanisme proses (The Generic AM Process) 1.4 Keuntungan AM (The Benefits of AM) 1.5 Perbedaan antara AM dan CNC (Distinction Between AM and CNC Machining) 2 Perkembangan teknologi AM (Development of Additive Manufacturing Technology) 2.1 Computer-Aided Design Technology 2.2 The Use of Layers 2.3 Classification of AM Processes 2.4 Metal Systems 2.5 Hybrid Systems 2.6 Milestones in AM Development 3 Generalized Additive Manufacturing Process Chain 3.1 The Eight Steps in Additive Manufacture 3.2 Variations from One AM Machine to Another 3.3 Materials Handling Issues 3.4 Design for AM 3.5 Application Areas That Don't Involve Conventional CAD Modeling 4 Vat Photo-polymerization Processes 4.1 Vat Photopolymerization Materials 4.2 Reaction Rates 4.3 Laser Scan						

		Vat Photopolymerization 4.4 Photopolymerization Process Modeling 4.5 Vector Scan VP Machines 4.6 Scan Patterns 4.7 Vector Scan Micro-Vat Photopolymerization 5 Powder Bed Fusion Processes 5.1 Materials 5.2 Powder Fusion Mechanisms 5.3 Process Parameters and Modeling 5.4 Powder Handling 5.5 PBF Process Variants and Commercial Machines 6 Extrusion-Based Systems 6.1 Basic Principles 6.2 Plotting and Path Control 6.3 Fused Deposition Modeling from Stratasys 6.4 Bioextrusion 7 Material Jetting 7.1 Evolution of Printing as an Additive 7.2 Manufacturing Process 7.3 Materials for Material Jetting 7.4 Material Processing Fundamentals 7.5 MJ Process Modeling 7.6 Material Jetting Machines 8 Binder Jetting 8.1 Materials 8.2 Process Variations 8.3 BJ Machines 8.4 Process Benefits and Drawbacks 9 Sheet Lamination Processes 9.1 Materials 9.2 Material Processing Fundamentals 9.3 Ultrasonic Additive Manufacturing 10 Directed Energy Deposition Processes 10.1 General DED Process Description 10.2 Material Delivery 10.3 DED Systems 10.4 Process Parameters 10.5 Typical Materials and Microstructure 10.6 Processing–Structure–Properties Relationships Direct Write Technologies 11.1 Ink-Based DW 11.2 Laser Transfer DW 11.3 Thermal Spray DW 11.4 Beam Deposition DW 11.5 Liquid-Phase Direct Deposition 11.6 Beam Tracing Approaches to Additive/Subtractive DW 12 The Impact of Low-Cost AM Systems 12.1 Intellectual Property 12.2 Disruptive Innovation 12.3 The Maker Movement he Future of Low-Cost AM 13 Guidelines for Process Selection 13.1 Selection Methods for a Part 13.2 Challenges of Selection 13.3 Example System for Preliminary Selection Production Planning and Control 14 Post-processing 14.1 Support Material Removal 14.2 Surface Texture Improvements 14.3 Accuracy Improvements 14.4 Aesthetic Improvements Preparation for Use as a Pattern 15 Software Issues for Additive Manufacturing 15.1 Preparation of CAD Models: The STL File 15.2 Problems with STL Files 15.3 STL File Manipulation 15.4 Additional Software to Assist AM The Additive Manufacturing File Format 16 Direct Digital Manufacturing 16.1 Align Technology 16.2 Siemens and Phonak 16.3 Custom Footwear and Other DDM Examples 16.4 DDM Drivers Manufacturing Versus Prototyping				
Pustaka	Utama:					
	1. Teknologi CAD/CAM/CAE & Rapid Prototyping dalam Industri Manufaktur, Agus Dwi Anggono, Buku Ajar, ISBN 978-602-361-139-3, 2018.					
	Pendukung:					
	1. Additive Manufacturing Technologies, 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker. Springer New York, NY softcover ISBN978-1-4939-4455-2 2. Additive Manufacturing, Science and Technology, Emrah Celik In the series De Gruyter Textbook. https://doi.org/10.1515/9781501518782 3. Additive Manufacturing – Developments in Training and Education Eujin Pei, Mario Monzón, Alain Bernard. Springer Cham eBook ISBN978-3-319-76084-1 4. Additive Manufacturing of Metals From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry John O. Milewski Springer Series in Materials Science ISBN: 978-3-319-58205-4					
Dosen Pengampu	Prof. Agus Dwi Anggono, S.T., M.Eng., Ph.D					
Matakuliah syarat	Tidak ada					
Minggu Ke	Kemampuan akhir tiap tahapan belajar (Sub-CLO)	Penilaian		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]	Materi Pembelajaran [Pustaka]	Bobot Penilaian(%)
		Indikator	Kriteria & Teknik			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1 2 3 4	Teknologi komputasi bidang CAD/CAM/CAE yang berkaitan dengan rekayasa produksi rapid prototyping	Mampu menerangkan tentang: 1.1 Pengertian Additive Manufacturing 1.2 Komponen peralatan pada AM 1.3 Mekanisme proses (The Generic AM Process) 1.4 Keuntungan AM (The Benefits of AM) 1.5 Perbedaan antara AM dan CNC (Distinction Between AM and CNC Machining)	Kriteria: - Partisipasi - Tugas Individu - Tugas Kelompok Teknik Penilaian: partisipasi, tes tertulis, Bentuk: rubrik,	Teknik Pembelajaran: Luring Bentuk Pembelajaran: Perkuliahan PB: 2x50" Metode Pembelajaran: diskusi kelompok, kolaboratif, Penugasan: - Tugas Individu - Tugas Kelompok PT=2x70" KM=2x70"	1 Pendahuluan dan prinsip dasar (Introduction and Basic Principles) 1.1 Pengertian Additive Manufacturing 1.2 Komponen peralatan pada AM 1.3 Mekanisme proses (The Generic AM Process) 1.4 Keuntungan AM (The Benefits of AM) 1.5 Perbedaan antara AM dan CNC (Distinction Between AM and CNC Machining) 2 Perkembangan teknologi AM (Development of Additive Manufacturing Technology) 2.1 Computer-Aided Design Technology 2.2 The Use of Layers 2.3 Classification of AM Processes 2.4 Metal Systems 2.5 Hybrid Systems 2.6 Milestones in AM Development 3 Generalized Additive Manufacturing Process Chain 3.1 The Eight Steps in Additive Manufacture 3.2 Variations	30%

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5 6 7 9	Merancang prototype dengan teknik rapid prototyping	Mampu menerangkan tentang: 5 Powder Bed Fusion Processes 5.1 Materials 5.2 Powder Fusion Mechanisms 5.3 Process Parameters and Modeling 5.4 Powder Handling 5.5 PBF Process Variants and Commercial Machines 6 Extrusion-Based Systems 6.1 Basic Principles 6.2 Plotting and Path Control	Kriteria: Partisipasi Tugas Individu Tugas Kelompok Teknik Penilaian: partisipasi, tes tertulis, uts, Bentuk: rubrik, portofolio,	Teknik Pembelajaran: Luring Bentuk Pembelajaran: Perkuliahan dan diskusi PB: 2x100" Metode Pembelajaran: diskusi kelompok, studi kasus, kolaboratif, Penugasan: Tugas Individu Tugas Kelompok PT=2x140" KM=2x140"	5 Powder Bed Fusion Processes 5.1 Materials 5.2 Powder Fusion Mechanisms 5.3 Process Parameters and Modeling 5.4 Powder Handling 5.5 PBF Process Variants and Commercial Machines 6 Extrusion-Based Systems 6.1 Basic Principles 6.2 Plotting and Path Control 6.3 Fused Deposition Modeling from Stratasys 6.4 Bioextrusion 7 Material Jetting 7.1 Evolution of Printing as an Additive 7.2 Manufacturing Process 7.3 Materials for Material Jetting 7.4 Material Processing Fundamentals 7.5 MJ Process Modeling 7.6 Material Jetting Machines 8 Binder Jetting 8.1 Materials 8.2 Process Variations 8.3 BJ Machines 8.4 Process Benefits and Drawbacks [1. Teknologi CAD/CAM/CAE & Rapid Prototyping dalam Industri Manufaktur, Agus Dwi Anggono, Buku Ajar, ISBN 978-602-361-139-3, 2018. 2. Additive Manufacturing Technologies, 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker. Springer New York, NY softcover ISBN978-1-4939-4455-2 3. Additive Manufacturing – Developments in Training and Education Eujin Pei, Mario Monzón, Alain Bernard. Springer Cham	35%

		6.3 Fused Deposition Modeling from Stratasys 6.4 Bioextrusion 7 Material Jetting 7.1 Evolution of Printing as an Additive 7.2 Manufacturing Process 7.3 Materials for Material Jetting 7.4 Material Processing Fundamentals 7.5 MJ Process Modeling 7.6 Material Jetting Machines 8 Binder Jetting 8.1 Materials 8.2 Process Variations 8.3 BJ Machines 8.4 Process Benefits and Drawbacks			eBook ISBN978-3-319-76084-1 4. Additive Manufacturing of Metals From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry John O. Milewski Springer Series in Materials Science ISBN: 978-3-319-58205-4]	
8	Evaluasi Tengah Semester / Ujian Tengah Semester					
10 11 12 13 14 15	Mendesain prototype pada sebuah produk komponen kendaraan berbasis rapid pototiping	Mahasiswa mampu memahami tentang: 9 Sheet Lamination Processes 9.1 Materials 9.2 Material Processing Fundamentals 9.3 Ultrasonic Additive Manufacturing 10 Directed Energy Deposition Processes	Kriteria: Partisipasi Tugas Individu Tugas Kelompok Teknik Penilaian: observasi, tes tertulis, uas, Bentuk: rubrik, portofolio,	Teknik Pembelajaran: Luring Bentuk Pembelajaran: Perkuliahan dan diskusi PB: 2x100" Metode Pembelajaran: diskusi kelompok, kolaboratif, Penugasan: Tugas Individu Tugas Kelompok PT=2x140" KM=2x140"	9 Sheet Lamination Processes 9.1 Materials 9.2 Material Processing Fundamentals 9.3 Ultrasonic Additive Manufacturing 10 Directed Energy Deposition Processes 10.1 General DED Process Description 10.2 Material Delivery 10.3 DED Systems 10.4 Process Parameters 10.5 Typical Materials and Microstructure 10.6 Processing–Structure–Properties Relationships Direct Write Technologies 11.1 Ink-Based DW 11.2 Laser Transfer DW 11.3 Thermal Spray DW 11.4 Beam Deposition DW 11.5 Liquid-Phase Direct Deposition 11.6 Beam Tracing Approaches to Additive/Subtractive DW 12 The Impact of Low-Cost AM Systems 12.1 Intellectual Property 12.2 Disruptive	35%

10.1	General DED Process Description
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10.5	Typical Materials and Microstructure
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12.3	The Maker Movement
	he Future of Low-Cost AM
13	Guidelines for Process Selection

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2.	Additive Manufacturing Technologies, 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker. Springer New York, NY softcover ISBN978-1-4939-4455-2
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5.	Additive Manufacturing of Metals From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry John O. Milewski Springer Series in Materials Science ISBN: 978-3-319-58205-4
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	16.4 DDM Drivers				
	Manufacturing Versus Prototyping				
16	Evaluasi Akhir Semester / Ujian Akhir Semester				