Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184301 Advanced Electric Circuits
2	**Credit(s)**	:	3
3	**Semester**	:	III
4	**Lecturer(s)**	:	Hendra Kusuma, Totok Mujiono, Djoko Purwanto, Fajar Budiman
5	**Description of Course**	:	Advanced Electrical Circuits is intended for use in a classroom course that deals with currents, Voltages and Power at Frequency domain, a Sinusoid function, Phasor Concept, Steady State Sinusoid Analysis, Thevenin and Norton Theorems, Temporary AC Power and Average AC Power, Maximum Power Transfer Theorems, Power Factor, Complex Power, Power Factor Correction, 3 phase AC Circuit, 3 Phase Power Measurement. Electrical System 3 Balanced and Unbalanced Phases. 3 phase Phase Power Measurement, magnetic coupling circuit, Linear and Ideal Transformer, as well as Ideal Auto transformer.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU08) Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertsei independently
7	**Course Learning Outcomes**	:	**Knowledge** Students should be able to understand the theory, concepts and principles of electrical circuit engineering, current, voltage and AC power single phase using Phasor concept. They also are should be able to understand 3 phase circuit, as well as magnetic coupling circuit. **Specific Skill** Students should Able to describe the problem solving of electrical circuit engineering in frequency domain with phasor analysis on electric power system, control system, multimedia telecommunication, or electronics

			General Skill Students should be able to analyze and design passive AC circuits on electric power system, control system, multimedia telecommunication, or electronics by using phasor concepts **Attitude** Students should show a responsible attitude towards the work in the field of AC circuit analysis independently especially in analyzing and solving circuit problems in the frequency domain.
8	**Main Subjects**	:	1. Sinusoidal Functions, 2. Phasor Concepts, 3. AC Steady state analysis 4. AC Power analysis 5. 3 Phase AC Circuits 6. Mutual Inductance Circuits
9	**Reference(s)**	:	[1] Alexander Charles K., Sadiku Matthew O. N., Fundamentals of Electric Circuit, Fifth edition, McGraw-Hill, New York, 2013. [2] Hyatt, William H.,Kemmerly Jack E, Engineering circuit analysis, McGraw-Hill, New York, 1983. [3] Irwin, J. David, Nelms, R. Mark, Basic engineering circuit analysis, 11th edition, John Wiley & Sons, USA, 2015.
10	**Prerequisite(s)**	:	Electric Circuits

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INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184305 Signals and Systems
2	**Credit(s)**	:	3
3	**Semester**	:	III
4	**Lecturer(s)**	:	Team
5	**Description of Course**	:	The Signal and System course discusses the representation of signals and systems, the concept of a continuous time-invariant Linear Time-Invariant (LTI) system, Fourier series of continuous time signals, Fourier continuous time transformations and their applications, Laplace transforms and their applications, the discrete-time LTI system concepts, Fourier series discrete time signal, Fourier time discrete transformation and Z transformation.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work. **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently. (S12) Working together to be able to make the most of his/her potential.
7	**Course Learning Outcome**	:	**Knowledge** Mastering the concept of signals and linear systems in the complex domain, frequency and frequency domains. **Specific Skill** Being able to analyze signals and linear time-invariant systems in the continuous time domain and discrete time domain. **General Skill** Being able to use Matlab / Simulink software to visualize and experiment the concepts of signals and linear systems. **Attitude** Demonstrate a responsible attitude towards the work in the field of expertise independently.

			Working together to be able to take full advantage of their potential.
8	**Main Subjects**	:	1. Signal and System Concepts 2. Continuous Time LTI System 3. Fourier Continuous Time Transform 4. Laplace transform 5. Discrete Time LTI System 6. Fourier Time Discrete Transformation 7. Transformation Z
9	**Reference(s)**	:	[1] Fatoni, Ali. “Diktat Sistem Linear” [2] S.Soliman, Samir and D.Srinath,M. : "Continous and Discrete Signal and Systems", Prentice-Hall, Englewood Cliffs, New Jersey 1990. [3] V. Oppenheim, A and T. Young, Ian : "Signal and Systems", Prentice-Hall of India, New Delhi 1990 [4] Sanjit K Mitra: “Digital Signal Processing : A Computer - Based Approach.” 4th Edition. Mcgraw Hill Education, 2013
10	**Prerequisite(s)**	:	Electric Circuits

Syllabus
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INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184306 Electronic Circuits
2	**Credit(s)**	:	3
3	**Semester**	:	III
4	**Lecturer(s)**	:	Muhammad Rivai, Totok Mujiono, Astria Nur Irfansyah, Fajar Budiman
5	**Description of Course**	:	The course of Electronic Circuits discusses: Analysis, simulation, design, and application of Semiconductor Diode, Bipolar Junction Transistor, and Field-Effect Transistor circuits; Analysis of frequency response of the transistor circuits; Analysis of Power Amplifier, Differential Amplifier, Feedback & Oscillator, and Power Supply circuits; Analysis, simulate, design, and application of Silicon-Controlled Rectifier, Alternating Current Diode, Triode for Alternating Current, Unijunction Transistor, and Programmable Unijunction Transistor circuits.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concepts and principles of electronic components for analysis, simulation, design, and application of electronic circuits. **Specific Skill** Being able to describe the analysis, simulation, design, and application of electronic circuits. **General Skill** Being able to apply the analysis, simulation, design, and application of electronic circuits **Attitude**

			Demonstrating attitude of responsibility regarding the analysis, simulation, design, and application of electronic circuits independently.
8	**Main Subjects**	:	1. Semiconductor Diode 2. Bipolar Junction Transistor 3. Field-Effect Transistor 4. The frequency response of the transistor circuits 5. Power Amplifier 6. Differential Amplifier 7. Feedback & Oscillator 8. Power Supply 9. Silicon-Controlled Rectifier, Alternating Current Diode, Triode for Alternating Current, Unijunction Transistor, and Programmable Unijunction Transistor circuits
9	**Reference(s)**	:	[1] Muhammad Rivai, 2018. Lecture Note: Electronic Circuits [2] Robert L Boylestad and Louis Nashelsky, 2012. Electronic Devices and Circuit Theory, Prentice Hall, Inc.
10	**Prerequisite(s)**	:	Electrical Circuits (for students of the DEE) or Physics II (for students of the other Departments)

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1	**Course Code and Name**	:	EE184401 Digital Systems and Microprocessors
2	**Credit(s)**	:	4
3	**Semester**	:	IV
4	**Lecturer(s)**	:	Astria Nur Irfansyah, Totok Mujiono, Ronny Mardiyanto, Fajar Budiman
5	**Description of Course**	:	This course introduces concepts of digital systems and microprosessors. It covers a broad range of topics, which starts with the fundamental theory and design of digital systems, basic blocks of digital systems, continued with the topic of microprosessor systems, their components, and its fundamental programming concepts. Design of digital circuits through combinational and sequential circuit implementations in this course serves as the basis for the understanding and implementation of microprosessor systems, from architectural level to logic gate implementation. The study of microprocessor systems also includes concepts and implementations of low-level programming, subroutines, stack, interrupts, input/output interfacing, and memory.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU08) Able to perform self assessment of the group under their responsibility, and able to manage self- learning. **Attitude** (S09) To show responsibility on their works in the field of expertise.
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the fundamentals of digital systems and its technology, with topics covering binary number system, logic gates, combinational logic, sequential circuits, digital IC technology, as well as principles of microprocessor systems which includes implementation on the register transfer or logic gate level, instruction execution from a program, and

			the development of microprocessor based systems. **Specific skills** • Able to perform simplification of combinational logic circuits through Karnaugh Map. • Able to design and simulate ALU (arithmetic logic unit) designs as well as CPU (central processing unit) microarchitectures based on a simple instruction set. • Able to write and develop low-level programming codes for microprocessor systems. • Able to design simple microprocessor-based systems. **General skills** • Understands the concept of stored-program computer, including its components such as CPU, I/O unit, memory unit, & instruction set. • Understands the analysis and design of digital systems. • Understands low-level programming of microprocessor systems. **Attitude** Showing responsibility in the field of expertise.
8	**Main Subjects**	:	1. Theory of digital techniques, binary number system, Boolean algebra, logic gates. 2. Combinational logic circuits, sum-of-product, combinational circuit simplification, Karnaugh map method. 3. Sequential logic circuits, state machines, flip-flop, registers. 4. Digital arithmetics, adders, two's complement, BCD, floating point, multiplier, carry propagation. 5. Digital IC technology, logic families, noise margin, TTL, CMOS, fan in/fan out. 6. Computer models and architecture (CPU, I/O, memory, data and instruction buses, Von Neumann architecture, Harvard architecture, memory addressing, instruction set, machine code). 7. Fundamental assembly programming, development toolchain, subroutine, stack, interrupt. 8. Interfacing techniques, memory interfacing, input/output ports.
9	**Reference(s)**	:	[1] David Harris & Sarah Harris, "Digital Design and Computer Architecture", 2nd edition, Morgan Kaufmann, 2013, USA. [2] Morris Mano, Charles Kime, "Logic and Computer Design Fundamentals", 5th edition, Pearson, 2015. [3] David A. Patterson dan John L. Hennessy, "Computer Organization & Design: The Hardware / Software Interface", Morgan Kaufmann, 2017, USA.
10	**Prerequisite(s)**	:	Fundamentals of programming

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1	**Course Code and Name**	:	EE184404 Introduction to Control Systems
2	**Credit(s)**	:	3 credits
3	**Semester**	:	V
4	**Lecturer(s)**	:	Teaching team
5	**Description of Course**	:	Introduction to Control Systems is the underlying subject of control system engineering field of studies. This course discusses how its work, how to design and analyze it. The learning materials as introductory notions is control system components, open loop and closed loop system configurations and examples of its applications. Then forwarded with system modelling of electrical, mechanical and electro-mechanical systems. Furthermore, the important thing is about the block diagram, the signal flow diagram, the system characteristics, response analysis in the time domain and the system stability. Having completed the concept, it also learns about the design of PID controller and its tuning method.
6	**Learning Outcome**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU02) Being able to demonstrate independent performance, quality, and measurable **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcome**	:	**Knowledge** Ability to explain system modelling concepts and principles, stability analysis, determine response specifications and control system design. **Specific Skill**

			Able to model the system, analyze the stability of the system, determine the response specifications and design the control system. **General Skill** Able to use Matlab simulation software or the like for analysis and visualization of system responses. **Attitude** Have a passion to improve knowledge in the field of control system to improve the quality of Indonesian society in the mastery of technology.
8	**Main Subjects**	:	1. Definition and concept of control ~~regulatory~~ system 2. Dynamic system mathematical model in the form of differential equations, transfer function, block diagram, and graph of signal flow 3. Specification of system response 4. System Stability Analysis 5. Design of PID controller analytically 6. Tuning PID controller with Ziegler-Nichols method 7. Simulation system settings with PID controller
9	**Reference(s)**	:	[1] Ogata, Katsuhiko: "Modern Control Engineering", 3rd Ed., Prentice-Hall 1997 [2] Kuo, Benjamin C. "Automatic Control System 8th Ed." [3] Jacob, J.M.: "Industrial Control Electronics: Application and Design", PHI 1989
10	**Prerequisite(s)**	:	Signals and Systems

No	Capaian Pembelajaran Pokok Bahasan	Materi Pembelajaran	Metode Pembelajaran (Estimasi Waktu)	Asesmen		
				Indikator Capaian Pembelajaran	Pengalaman Belajar*	Bobot (%)
1	Mampu menjelaskan definisi dan konsep sistem pengaturan	Definisi dan konsep sistem pengaturan	- Belajar Mandiri – (1 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (1 x 3 x 50 menit) - Belajar Terstruktur (1 x 3 x 60 menit)	• Mampu menjelaskan definisi sistem pengaturan • Mampu menjelaskan elemen sistem pengaturan • Mampu menjelaskan struktur sistem open loop dan closed loop • Mampu menjelaskan contoh aplikasi sistem pengaturan	Tugas	**10**
2	Menjelaskan konsep pemodelan sistem dinamik dalam bentuk bentuk persamaan differensial, fungsi alih, diagram blok, dan grafik aliran sinyal	Model matematika sistem dinamik dalam bentuk persamaan differensial, fungsi alih, diagram blok, dan grafik aliran sinyal	- Belajar Mandiri – (4 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (4 x 3 x 50 menit) - Belajar Terstruktur (4 x 3 x 60 menit)	• Mampu menjelaskan konsep pemodelan matematika sistem elektronik • Mampu menjelaskan konsep pemodelan matematika sistem mekanik • Mampu menjelaskan konsep pemodelan matematika sistem elektro-mekanik • Mampu menjelaskan representasi sistem dengan blok diagram • Mampu menjelaskan representasi sistem dengan Signal Flow Graph	Tugas dan ETS	**20**

3	Mampu menjelaskan cara mendapatkan spesifikasi respon sistem	Spesifikasi respon sistem	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	• Mampu menjelaskan spesifikasi transien dan steady state sistem orde I • Mampu menjelaskan spesifikasi transien dan steady state sistem orde II • Mampu menjelaskan konsep Analisa kesalahan dan tipe sistem	Tugas, EAS	**15**
4	Mampu menjelaskan konsep Analisa Kestabilan Sistem	Analisa Kestabilan Sistem	- Belajar Mandiri – (1 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (1 x 3 x 50 menit) - Belajar Terstruktur (1 x 3 x 60 menit)	• Mampu menentukan dan menganalisis kestabilan sistem dengan Analisa routh hurwitz	Tugas, EAS	**10**
5	Mampu menjelaskan konsep dan langkah-langkah dalam merancang kontroler PID secara analitik	Perancangan kontroler PID secara analitik	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	• Mampu menjelaskan konsep kontroler P, PI, PD, PID • Mampu mendesain kontroler PID secara analitik	**Tugas, EAS**	**15**

6	Mampu menjelaskan proses tuning kontroler PID dengan metode Ziegler-Nichols	Tuning kontroler PID dengan metode Ziegler-Nichols	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	• Mampu melakukan tuning kontroler dengan menggunakan metode Ziegler-Nichols		**15**
7	Mampu mensimulasikan sistem pengaturan dengan kontroler PID	Simulasi sistem pengaturan dengan kontroler PID	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	• Mampu mensimulasikan sistem pengaturan menggunakan Matlab	Tugas, EAS	15

*) Presentasi, tugas, quiz, praktikum lab

Syllabus
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1	**Course Code and Name**	:	EE184502 Analog Circuits
2	**Credit(s)**	:	2
3	**Semester**	:	V
4	**Lecturer(s)**	:	Hendra Kusuma, Astria Nur Irfansyah, Fajar Budiman, Ronny Mardiyanto
5	**Description of Course**	:	The Analog Circuit course discusses the characteristics of integrating operational amplifier circuits, feedback and negative feedback concepts, feedback amplifier circuit, comparator, voltage level detector, hysteresis, square wave circuit, triangle, saw-tooth, Wien oscillator and analog computer, integrator, differentiator , as well as active filters of Butterworth LPF, HPF, BPF, and BSF implemented on operational amplifiers.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU08) Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering and understanding the concepts and principles of natural science and mathematical characteristics of operational amplifiers, and students are able to understand theories and concepts of negative feedback amplifiers, positive feedback, and analog computers that are applied using operational amplifiers. **Specific Skill** Able to analyze and design amplifier circuit, signal generator, oscillator, filter, and analog computer on operational amplifier. **General Skill** Able to analyze and design analog circuits on the system in the field of Electro using operational amplifier.

			Attitude Demonstrating attitude of responsibility on his/her work in the field of analog circuit analysis, especially the operational amplifier circuit independently.
8	**Main Subjects**	:	1. The basic characteristics of integrating operational amplifier circuits 2. Amplifier: Inverting, Non-inverting, adder, buffer, differential, and instrumentation, 3. Comparator: open loop (zero crossing detector), positive feedback (with or without hysteresis) 4. Signal generator and Wien oscillator 5. Analog computer (Integrator, differentiator, adder) 6. Active Filter Butterworth (LPF, HPF, BPF, BSF)
9	**Reference(s)**	:	[1] Diktat of Analog Circuits, Hendra Kusuma 2018 [2] Robert F Coughlin, Frederick F Driscoll, Operational Amplifier and Linear Integrated Circuit, Prentice-Hall International, 2001. [3] James M. Fiore, Operational Amplifiers & Linear Integrated Circuits: Theory and Application, 2016 [4] Ramakant A Gayakward, Op-Amp dan Linear Integrated Circuits, Prentice-Hall, 2000.
10	**Prerequisite(s)**	:	Electronic Circuits

Syllabus
Department of Electrical Engineering
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1	**Course Code and Name**	:	EE184521 Control System Analysis and Design
2	**Credit(s)**	:	3 Credits
3	**Semester**	:	V
4	**Lecturer(s)**	:	Ir. Rusdhianto Effendie A.K., MT
5	**Description of Course**	:	This course is a continuation of the Basic Control System course. After students understand about the response characteristics in the time domain, the important thing to learn is the analysis of responses in the frequency domain as well as the modern control techniques that use the mathematical model of the system in state space. Therefore, the scope studied in this course is the technique of analyzing and designing a regulatory system in frequency domain (using root locus and bode diagram) as well as in state space.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work. **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently.
7	**Course Learning Outcome**	:	**Knowledge** Mastering the techniques of analysis and design of control systems in the time domain and frequency as well as in the representation of state equations. **Specific Skill** Able to analyze and designing control system by using root locus, bode diagram, nyiquist diagram and in state space.

			General Skill Able to simulate the design result of the system using simulation software. **Attitude** Have a passion to improve knowledge in the field of control system to improve the quality of Indonesian society in the mastery of technology.
8	**Main Subjects**	:	1. System stability analysis using Root Locus method 2. Stability analysis of frequency domain using Bode diagram method and Nyquist diagram 3. Design of Root Locus based compensator 4. Design of Bode Diagram based compensator 5. Representation of the system in the form of state equations 6. The canonical form of state equations and their transformations 7. The intrinsic properties of state equations (controllability & observability) 8. Analysis of system stability in the form of state equations 9. Design of state feedback controller 10. Decoupling process of MIMO system using algebra block diagram and state feedback 11. Cascade system design 12. Design of error-based model controller: Sliding Mode, Inverse error model
9	**Reference(s)**	:	[1] Ogata, Katsuhiko. "Modern Control Engineering", 5th Edition, Pearson, 2009. [2] Kuo, C. Benjamin. "Automatic Control System", Wiley, 2002. [3] Franklin, F. Gene, Powell, J. David, Naeini, Abbas Emami. "Feedback Control of Dynamic System 6th edition" [4] Nise, Norman S., "Control System Engineering". Wiley. 2015
10	**Prerequisite(s)**	:	Introduction to Control Systems

No	Capaian Pembelajaran Pokok Bahasan	Materi Pembelajaran	Metode Pembelajaran (Estimasi Waktu)	Asesmen		
				Indikator Capaian Pembelajaran	Pengalaman Belajar*	Bobot (%)
1	Memahami konsep analisis kestabilan sistem menggunakan metode Root Locus serta pada domain frekuensi menggunakan metode diagram Bode dan diagram Nyquist	Analisis kestabilan sistem menggunakan metode Root Locus serta pada domain frekuensi menggunakan metode diagram Bode dan diagram Nyquist	- Belajar Mandiri – (3 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (3 x 3 x 50 menit) - Belajar Terstruktur (3 x 3 x 60 menit)	Mampu merepresentasikan pole dan zero sistem	Tugas, ETS	**20**
				Mampu menggambarkan root locus, bode diagram dan nyquist		
				Mampu menampilkan gambar root locus, bode diagram dan nyquist menggunakan software simulasi		
				Mampu menentukan kestabilan sistem menggunakan root locus, bode diagram dan nyquist		
2	Mampu merancang kompensator berbasis Root Locus dan diagram Bode	Desain kompensator menggunakan Root Locus dan Diagram Bode	- Belajar Mandiri – (3 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (3 x 3 x 50 menit) - Belajar Terstruktur (3 x 3 x 60 menit)	Mampu merancang kompensator dengan metode root locus	Tugas, ETS	**20**
				Mampu merancang kompensator dengan metode Diagram Bode		
3	Mampu merepresentasikan sistem dalam bentuk persamaan state, bentuk kanonik persamaan state	1) Representasi sistem dalam bentuk	- Belajar Mandiri – (3 pertemuan x 3 sks x 60 menit)	Mampu merepresentasikan sistem dalam bentuk persamaan state	Tugas, ETS dan EAS	**20**
				Mampu memahami bentuk kanonik persamaan state dan transformasinya		

	dan transformasinya, menentukan sifat-sifat intrinsik persamaan state (controllability & observability), menganalisis kestabilan sistem dalam bentuk persamaan state, serta mendesain kontroler state feedback	persamaan state 2) Bentuk kanonik persamaan state dan transformasinya 3) Sifat-sifat intrinsik persamaan state (controllability & observability) 4) Analisis kestabilan sistem dalam bentuk persamaan state	- Pembelajaran di Kelas (3 x 3 x 50 menit) - Belajar Terstruktur (3 x 3 x 60 menit)	Memahami sifat-sifat intrinsik persamaan state (controllability dan observability) Mampu menganalisis kestabilan sistem dalam bentuk persamaan state Mampu mendesain kontroler state feedback		
4	Mampu memahami proses Decoupling sistem MIMO menggunakan aljabar diagram blok dan state feedback		- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas	Proses analsisis decoupling sistem MIMO menggunakan aljabar diagram blok Proses analsisis decoupling sistem MIMO menggunakan state feedback	Tugas dan EAS	**20**

			(2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)			
5	Desain sistem Cascade dan kontroler berbasis error model: Sliding Mode, Invers error model	1) Desain sistem Cascade 2) Desain kontroler berbasis error model: Sliding Mode, Invers error model	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	Mampu mendesain sistem cascade Mampu mendesain kontroler sliding mode dan invers error model	**Tugas dan EAS**	

*) Presentasi, tugas, quiz, praktikum lab

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1	**Course Code and Name**	:	EE184522 System Automation
2	**Credit(s)**	:	3
3	**Semester**	:	V
4	**Lecturer(s)**	:	Dr. Ir. Mochammad Rameli
5	**Description of Course**	:	This course provides an understanding to the course participants about the forms of automation system application in the industry, various automation systems, control principles and various design methods of ladder in the field of automation, and instrumentation technology and process control.
6	**Learning Outcome**	:	**Knowledge** (P01) Mastering the concepts, procedures and principles of engineering and manifesting them in the form of procedures required for analysis and design of systems in the field of Electronics, Power Systems, Multimedia Telecommunications, and Control System. **Specific Skill** (KK01) Being able to formulate engineering problems in the field of Electronics, Power Systems, Multimedia Telecommunications, and Control System. **General Skill** (KU12) Being able to implement information and communication technology in the context of execution of its work. **Attitude** (S09) Shows a responsible attitude towards the work in the field expertise independently. (S12) Working together to be able to take full advantage of their potential.
7	**Course Learning Outcome**	:	**Knowledge** Mastering the concepts and principles of engineering and make it happen in the form of procedures necessary for the analysis and design of electric power systems, regulatory systems, multimedia telecommunications, or electronics **Specific Skill** Able to analyze and design automation systems in the industry able to provide consultation on design and development of industrial automation system

			General Skill Able to apply various design method of ladder diagram to Programmable Logix Controller (PLC) equipment Ability to apply products technology in system and contol other **Attitude** Show a responsible attitude towards the work in the field of expertise independently
8	**Main Subjects**	:	1. The concept of system automation 2. System automation equipment 3. Design of ladder diagram based on sequence chart 4. Design of ladder diagram based on cascade method 5. Design of ladder diagram based on Grafchet 6. Design of ladder diagram based on State diagram 7. Design of ladder diagram based on Huffman method 8. Design of ladder diagram based on Petri-net
9	**Reference(s)**	:	[1] D. Pessen, Industrial Automation, Wiley, 1989 [2] S. Baranov, Logic Synthesis for Control Automata, Kluwer Academic Publisher, 1994 [3] Applying Structured Analysis To Automation Systems (Paper 1) [4] The Principles of State Logic Control (Paper 2) [5] Tadao Murata, Petri Nets: Properties, Analysis and Applications, Proceedings of the IEEE, vol.77, no 4, April 1989 (paper 3)
10	**Prerequisite(s)**	:	Introduction to Control Systems

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184523 Optimization Techniques
2	**Credit(s)**	:	4
3	**Semester**	:	V
4	**Lecturer(s)**	:	Nurlita Gamayanti
5	**Description of Course**	:	Optimization Techniques course discusses optimization concept, optimization mathematical basic, analytical solution for optimization problems, Numerical solution for unconstraint optimization problem, Linear programming and its variants, deterministic or stochastic dynamic programming, and metaheuristic methods.
6	**Learning Outcome**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. (KU02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. (KU05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertsei independently
7	**Course Learning Outcome**	:	**Knowledge** Mastering the concept of optimization and various forms of optimization issues and methods of completion. **Specific Skill** Able to get mathematical model of optimization problem and solve various optimization problems by using analytical approach, numerical

			approach, matrix approach and metaheuristic method. **General Skill** Able to use Matlab, Delphi and Visual C software to solve optimization problems. **Attitude** Demonstrate a responsible attitude towards the work in the field of expertise independently.
8	**Main Subjects**	:	1. Optimization Concepts 2. Basic - Basic Mathematics Optimization 3. Numerical Solutions Optimization Problems 4. Linear Programming 5. Linear Programming Variations 6. Dynamic Deterministic Programming 7. Stochastic Dinamic Programming 8. Case Studies 9. Metaheuristic Method
9	**Reference(s)**	:	[1] Alkaff, A. dan Gamayanti, N. Diktat Kuliah Penyelidikan Operasi [2] Analisa Hillier and Lieberman., "Introduction to Operation Research", 8th Edition, Mc Graw Hill international Edition, 2004 [3] Hamdy A taha., "Operation Research : an Introduction", 8th Edition, Prentice Hall, 2006 [4] WAGNER, H.M., "Principles of Operations Research", 2nd edition", Prentice-Hall, New Jersey 1980.
10	**Prerequisite(s)**	:	Ordinary and Partial Differential Equations

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184541 Semiconductor Devices and Integrated Circuits
2	**Credit(s)**	:	3
3	**Semester**	:	5
4	**Lecturer(s)**	:	Astria Nur Irfansyah, Rudy Dikairono
5	**Description of Course**	:	This course develops the understanding of semiconductor devices and skills in integrated circuit (IC) design. The topics include theory of semiconductor materials, operating principles and fabrication of semiconductor devices, and the design of digital, analogue, and mixed signal IC, in CMOS (complementary metal-oxide semiconductor) technology. The first part of the course introduces fundamental theories and operating principles of semiconductor devices for various applications, as well as the fabrication process of semiconductor materials and integrated circuits. The second part of this course develops skills on IC design, covering schematic entry, simulation, and IC layout using computer aided design (CAD) tools.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK04) Being able to implement alternative solutions of engineering problems in power systems, control systems, multimedia telecommunications, or electronics by concerning in factors of economy, public health and safety, culture, social, and environment. **General Skill** (KU08) Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently. **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently.
7	**Course Learning Outcomes**	:	**Knowledge** Understanding the theory of semiconductor materials , various groups of semiconductor devices with their operating principles, semiconductor device and integrated circuits fabrication. Mastering analogue and digital integrated circuit design techniques in CMOS technology, from simulation stage to complete IC layout. **Specific Skill** Able to perform simulations of semiconductor device using computer software, design and simulation of analogue and digital CMOS circuits

			in SPICE, and able to implement CMOS IC layout using CAD tools. **General Skill** Understanding the theory of semiconductor materials, semiconductor devices and their operating principles, and semiconductor and IC fabrication technology. **Attitude** Showing responsibility in the field of expertise.
8	**Main Subjects**	:	1. Model of atom, semiconductor materials, energy band, doping. 2. PN junction, diodes. 3. Bipolar transistors. 4. MOSFET, FinFET, silicon-on-insulator. 5. Optoelectronic devices, organic semiconductor, high-frequency devices, quantum effect devices, power electronic devices. 6. VLSI technology fabrication, IC design flow. 7. Principles of integrated circuit layout, IC design tools & verification. 8. Design of CMOS static logic circuits, sequential circuits, and standard-cell layout. 9. Design of analogue CMOS circuits, layout techniques. 10. Design of simple mixed signal CMOS circuit, including ADC and DAC.
9	**Reference(s)**	:	[1] R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", 2nd edition, IEEE Press, Wiley-Interscience, 2005, USA. [2] Adel Sedra, Kenneth Smith, "Microelectronic Circuits: Theory and Applications", 6th edition, Oxford University Press, 2011. [3] Ben Streeman, Sanjay Banerjee, "Solid State Electronic Devices", 6th edition, Pearson, 2006.
10	**Prerequisite(s)**	:	Electronic Circuits

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184542 Data Acquisition and Signal Processing
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Tasripan
5	**Description of Course**	:	The course of Data Acquisition and Signal Processing discusses transducer characteristics, signal conditioning system, Isolation Circuits, Analog Filter Circuits, Digital to Analog signal conversion system (DAC), and Analog to Digital (ADC) signal conversion system. It discusses the concept of Digital Signal Processing from ADC results with Digital Filters for Data Acquisition System.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently (S12) Working together to be able to make the most of his/her potential
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of transducers and their characteristics, signal conditioning, digital to analog signal conversion systems (DAC), analog to digital signal conversion systems (ADC), and the concept of Digital Filters **Specific Skill** Able to analyze transducer and analog signal conditioning to convert to digital signal (ADC) and able to analyze conversion system of digtal to analog (DAC), and able to analyze signal processing along with programming.

			General Skill Able to design and realize data acquisition and signal processing system in various application fields. **Attitude** Demonstrating attitude of responsibility on work in his/her field independently concerning to Data Acquisition and Signal Processing Working together to be able to take full advantage of their potential concerning to Data Acquisition and Signal Processing
8	**Main Subjects**	:	1. Transducer and its characteristics. 2. Signal conditioning system 3. Isolation Circuit, and Analog Filter. 4. Flash type ADC, Counter Ramp, and Successive Approximation Register 5. DAC type Weighted Resistors and R2R Ladder. 6. Digital filter system (LPF, HPF, BPF, BSF) using matlab and z-plane method. 7. Data Acquisition and Signal Processing System
9	**Reference(s)**	:	[1] Joseph J Carr, Sensor and Circuits, Prentice Hall Inc., 1993. [2] Instrumentation Amplifier Application Guide, Charles Kitchin and Lew Counts, Analog Device, 1992. [3] Data Acquisition Handbook, Analog Device. [4] Data Acquisition Data Book, Nat Inst. [5] Digital Signal Analysis, Samuel D Stearns and Don R Hush, Prentice Hall Inc, 1990.
10	**Prerequisite(s)**	:	Embedded Electronic System

Syllabus
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Faculty of Electrical Technology
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1	**Course Code and Name**	:	EE184542 Embedded Electronic System
2	**Credit(s)**	:	4
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Ronny Mardiyanto
5	**Description of Course**	:	This course studies the Embedded Electronics System (System that has a chip that is programmed only for certain purposes) which is implemented in microcontroller system, consisting of microprocessor development to microcontroller, microcontroller type, programming language, and its implementation. This course also learns about how to use various types of microcontroller include: MCS 51 Microcontroller, AVR Microcontroller, Arduino, 32bit ARM Microcontroller, and Raspberry Pi.
6	**Learning Outcomes**	:	**Knowledge** (P04) Mastering the concepts, principles, and procedures which considers economical, social, and environment aspects in power systems, control systems, multimedia telecommunications, or electronics. (P05) Mastering the factual knowledge about information and communication technology, and the latest technology and its applications in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK04) Being able to implement alternative solutions of engineering problems in power systems, control systems, multimedia telecommunications, or electronics by concerning in factors of economy, public health and safety, culture, social, and environment (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work (KU13) Being able to apply entrepreneurship and understand technology-based entrepreneurship **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertsei independently (S10) Internalizing spirit of independence, struggle and entrepreneurship (S11) Trying his/her best to achieve perfect results

			(S12) Working together to be able to make the most of his/her potential
7	**Course Learning Outcomes**	:	**Knowledge** Master the basic concepts of microcontroller MCS 51, AVR, ARM 32 bit, and Embedded System. **Specific Skill** Mastering the concept of microcontroller type MCS51, AVR, ARM 32 bit, and Embedded System **General Skill** Able to implement microcontroller type MCS51, AVR, ARM 32 bit, and Embedded system board **Attitude** Able to internalize the spirit of independence, struggle, and entrepreneurship
8	**Main Subjects**	:	1. Introduction of Embedded Systems 2. Microcontroller MCS 51 3. GPIO, Timer, Counter, Interupt, Serial Communication, I2C, CAN, Onewire 4. Assembly Language for MCS 51 5. Basic Compiler and C ++ for MCS 51 6. AVR microcontroller 7. ARM Microcontroller 32bit 8. Raspberry Pi
9	**Reference(s)**	:	[1] Buku Ajar Embedded System, Ronny Mardiyanto, 2018 [2] Matt Richardson, Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly Media, 2012 [3] ARM Cortex M0 Nuvoton NuMicro, dalam bentuk CD [4] Manual Book STM32 [5] Robert Love, Linux Kernel Development, Addison-Wesley, 2010
10	**Prerequisite(s)**	:	Digital and Microprocessor System

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184543 Sensors and Actuators
2	**Credit(s)**	:	3
3	**Semester**	:	V
4	**Lecturer(s)**	:	Harris Pirngadi, Suwito
5	**Description of Course**	:	This course studies the implementation of digital circuits and systems using programmable hardware components of FPGA, which also include design procedures using HDL (Hardware Description Language) such as VHDL or Verilog, and the use of EDA tools for designing. Implementation includes design of combinational circuits, sequential circuits, FSM, DSP, digital filter circuit, and microprocessor design.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability **General Skill** (KU05) Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering basic concept of sensors and actuators **Specific Skill** Able to calculate analyze parameters in sensors and actuators. Able to design, engineer, and analyze sensors and actuators as needed. **General Skill** Able to analyze and take decisions in solving problems related to sensors and actuators. **Attitude** Demonstrating attitude of responsibility on work in his/her field of expertise independently

8	**Main Subjects**	:	1. Description of sensors, transducers and actuators. 2. Parameters and characteristics of sensors and actuators. 3. The working principle of voltage sensor, current and electric phases. 4. The working principle of position sensor, displacement, speed and acceleration. 5. The working principle of force, pressure and flow sensors. 6. The working principle of temperature sensor, humidity and pH. 7. The working principle of light intensity and radiation sensors. 8. Sensor manufacture technology. 9. Working principle of heater, solenoid and motor. 10. The working principle of the type of contactor, solid state switch and inverter.
9	**Reference(s)**	:	[1] Fraden, J. (2010). Handbook of modern sensors: physics, designs, and applications. New York, NY: Springer. [2] Morris, Alan S. (2006). Measurement and Instrumentation Principles. Elsevier, Butterworth Heinemann.
10	**Prerequisite(s)**	:	Electromagnetic Field Electronic Circuits

Syllabus
Bachelor Program of Departement of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184621 Control System Instrumentation
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Eka Iskandar
5	**Description of Course**	:	This course discusses the concept of applying instrumentation systems related to measurement, process variables, transducers, sensor selection, characteristics in the application of various sensors (mechanical, optical, thermal, other), converter signal conditioning circuit.
6	**Learning Outcome**	:	**Knowledge** (P01) Mastering the concepts, procedures and principles of engineering and manifesting them in the form of procedures required for analysis and design of systems in the field of power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Beimg able to formulate engineering problems in the field of power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work. **Attitude** (S09) Shows a responsible attitude towards the work in the field expertise independently. (S12) Working together to be able to take full advantage of their potential.
7	**Course Learning Outcome**		**Knowledge** Able to design the arrangement system along with the necessary instrumentation so that the control objectives are fulfilled able to make system arrangement diagram in physical diagram, block and instrumentation (P & ID) **Specific Skill** **General Skill**

			Attitude
8	**Main Subjects**	:	1. Introduction of intrumentation and regulatory system 2. Analog signal conditioning 3. Digital signal conditioning 4. Temperature sensor 5. Sensor level, pressure, weight and flow 6. The final control element 7. Computer in system settings 8. Communication system of process settings
9	**Reference(s)**	:	[1] Curtis D. Jonhson., "Process control instrumentation technology," 7th edition, PHI, New Jersey, 1989 [2] Wolfgang Altmann, "Practical Process Control for Engineers and Technicians," John Elsevier, 2005 [3] W.L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers," McGraw Hill, 2nd edition, 1990
10	**Prerequisite(s)**	:	

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184622 Digital Control Systems
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Ir. Rusdhianto Effendie A.K., MT
5	**Description of Course**	:	In this course the concept of control systems that use digital controllers (microprocessors or computers) is studied. Currently electronic devices are almost entirely based on digital systems, so all the signals processed in the controller are done digitally. In this course: analysis of control system in discrete time domain followed by controller design.
6	**Learning Outcome**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU02) Being able to demonstrate independent performance, quality, and measurable. **Attitude** (S12) Working together to be able to make the most of his/her potential.
7	**Course Learning Outcome**	:	**Knowledge** Mastering the concept of digital control systems ranging from systems analysis to designing the controller. **Specific Skill** Being able to analyze and design digital control systems. **General Skill** Mastering the concept of digital signals as well as to represent a digital control system in Matlab **Attitude** Able to complete independent tasks and groups by working together positively

8	**Main Subjects**	:	1. The concept of digital control system 2. Conversion and signal reconstruction 3. Time domain analysis on discrete time systems 4. Frequency domain analysis on discrete time systems 5. Design of digital controllers
9	**Reference(s)**	:	[1] Charles L. Phillips and H. Troy Nagle. Digital Control System Analysis and Design, third edition, Prentice Hall, 1995. [2] K. Ogata, Discrete-Time Control Systems, Second Edition, Englewood Cliffs, NJ: Prentice Hall, 1995, ISBN: 0-13-034281-5.
10	**Prerequisite(s)**	:	Control System Analysis and Design

No	Capaian Pembelajaran Pokok Bahasan	Materi Pembelajaran	Metode Pembelajaran (Estimasi Waktu)	Asesmen		
				Indikator Capaian Pembelajaran	Pengalaman Belajar*	Bobot (%)
1	Mampu memahami konsep sistem pengaturan digital	Pengantar sistem pengaturan digital dan ulasan sistem waktu kontinyu	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	• Mampu menjelaskan konsep sistem pengaturan digital	Tugas	**15**
2	Menguasai teknik konversi dan rekonstruksi sinyal	1) Konversi dan rekonstruksi sinyal : Sampling, transformasi Laplace sinyal tercacah, teorema Sampling. 2) Rekonstruksi Data, Zero order hold, analisis kawasan frekuensi.	- Belajar Mandiri – (2 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (2 x 3 x 50 menit) - Belajar Terstruktur (2 x 3 x 60 menit)	• Mampu mengkonversi dan merekonstruksi sinyal • Memahami teorema sampling	Tugas, ETS	**25**

3	Memahami teknik analisis domain waktu pada sistem waktu diskrit	1) Transformasi Z (Definisi, Sifat dan teorema, Inversi) 2) Pemetaan bidang s ke bidang z /efek lokasi pole pada frekuensi alamiah, damping ratio, overshoot, dll.	- Belajar Mandiri – (4 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (4 x 3 x 50 menit) - Belajar Terstruktur (4 x 3 x 60 menit)	• Mampu menganalisis sinyal dalam domain Z • Mampu melakukan pemetaan bidang s ke bidang Z dan menganalisisnya	Tugas, ETS	**20**
4	Mampu memahami teknik analisis domain frekuensi pada sistem waktu diskrit	1) Analisis sistem waktu diskrit 2) Variabel state waktu diskrit 3) Pendefinisian variabel state. 4) Transfromasi keserupaan, eigenvalue, eigenvector 5) Solusi persamaan state, state transition matrix	- Belajar Mandiri – (4 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (4 x 3 x 50 menit) - Belajar Terstruktur (4 x 3 x 60 menit)	• Memahami persamaan state dalam domain waktu diskrit • Mampu melakukan proses transformasi keserupaan dan menganalisis eigenvalue serta eigenvector • Mampu mendapatkan solusi presamaan state	Tugas, EAS	**20**

5	Mampu memahami konsep perancangan kontroler digital	Desain kontroler digital	- Belajar Mandiri – (4 pertemuan x 3 sks x 60 menit) - Pembelajaran di Kelas (4 x 3 x 50 menit) - Belajar Terstruktur (4 x 3 x 60 menit)	• Mampu mendesain kontroler digital • Mampu menganalisis kontroler digital	Tugas, EAS	**20**

*) Presentasi, tugas, quiz, praktikum lab

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184623 Linear System Computation
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Mochammad Sahal
5	**Description of Course**	:	The Linear System Computation course deals with computational techniques of linear system analysis methods in state space representations. The first part of this lecture contains matrix computations used in the representation of the state space model. Furthermore, presented computational techniques to perform simulation and operation on the linear system. At the end, described the methods of linear system analysis used to determine the behavior of the system.
6	**Learning Outcome**	:	**Knowledge** (P01) Mastering the concepts and principles of natural science and engineering mathematics and making it happen in the form of procedures necessary for analysis and design of power systems, regulatory systems, multimedia telecommunications, or electronics. (P02) Mastering the concepts, procedures and principles of engineering and making them happen in the form of procedures required for analysis and design of systems in the field of Electronics, Power System, Multimedia Telecommunication, and System Settings. (P03) Mastering the concepts, principles and procedures for designing electric power systems, regulatory systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Able to formulate engineering problems in the field of Electronics, Power Systems, Multimedia Telecommunications, and System Settings. (KK02) Able to describe the settlement of engineering problems on electrical power systems, regulatory systems, multimedia telecommunications, or electronics. **General Skill** (KU01) Able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation

			of science and technology that cares and implements the humanities value appropriate to its area of expertise. (KU02) Able to show independent performance, quality, and measurable. (KU12) Able to implement information and communication technology in the context of execution of its work. **Attitude** (S09) Demonstrate responsible attitudes towards the work in the field of expertise independently. (S11) Strive maximally to achieve perfect results (best). (S12) Working together to be able to take full advantage of their potential.
7	**Course Learning Outcome**	:	**Knowledge** Mastering the facts, concepts, procedures, and computational principles of linear algebra courses and linear systems. **Specific Skill** Mastering the strategy of designing computer programs for linear algebra and linear systems Numerically. **General Skill** Able to use Matlab / Simulink software to simulate and experiment the concept of linear algebra and linear control system. **Attitude** Demonstrate a responsible attitude towards the work in the field of expertise independently. Working together to be able to take full advantage of their potential.
8	**Main Subjects**	:	1. Euclidean and Generalization of Vector Space 2. Matrix and Determinant 3. Inner Products Space 4. Eigenvalue and Eigenvektor 5. Integral and Sum Convolution 6. Differential and Difference Equation Solutions 7. Controllability and Observability 8. Stability
9	**Reference(s)**	:	[1] Howard Anton and Chris Rorres, "Elementary Linear Algebra," 11th Edition, John Wiley & Sons, New York, 2014 [2] Biswa Nath Datta, "Numerical Methods for Linear Control Systems", Elsevier, California, 2004 [3] Steven C. Chapra, "Applied Numerical Methods with MatLab", 4th Edition, McGraw-Hill, 2017
10	**Prerequisite(s)**	:	Linear Algebra

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184641 Design of Analog Electronic Systems
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Muhammad Rivai
5	**Description of Course**	:	The course of Analog Electronic Systems Design discusses: Analysis, simulation, design and application of Operational Amplifier & its parameters, Precision Rectifier, Oscillator & Timer, Voltage-controlled Oscillator, One-shot Multivibrator, Pulse-width Modulation, Digital to Analog Conversion, Analog to Digital Conversion, Logarithmic and Antilog Amplifier, Linear Voltage Regulator, Switching Regulator, Analog Proportional-Integral-Derivative Controller, Switched Capacitor, Field Programmable Analog Array, Power Amplifier, Phase-locked Loop, Lock-in Amplifier circuits.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concepts and principles of design procedure for analysis, simulation, and application of analog electronic systems. **Specific Skill** Being able to describe the design of analog electronic systems for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability.

			General Skill Being able to apply the analysis, simulation, design, and application of analog electronic systems **Attitude** Demonstrating attitude of responsibility regarding the analysis, simulation, design, and application of analog electronic systems independently.
8	**Main Subjects**	:	1. Precision Rectifier 2. Osilator & Timer 3. Digital-Analog Conversion 4. Logarithmic & Antilog Amplifier 5. Voltage Regulator 6. Analog Proportional-Integral-Derivative Controller 7. Switched Capacitor 8. Power Amplifier 9. Phase-locked Loop 10. Lock-in Amplifier
9	**Reference(s)**	:	[1] Muhammad Rivai, 2018. Lecture Note: Design of Analog Electronic Systems [2] Thomas L Floyd and David Buchla, Fundamentals of Analog Circuits, Pearson Custom Publishing, 2012.
10	**Prerequisite(s)**	:	Analog Circuits

Syllabus
Bachelor Program of Department of Electrical Engineering
Faculty of Electrical Technology
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

1	**Course Code and Name**	:	EE184643 Design Using Programmable Device
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Fajar Budiman, Rudy Dikairono, Astria Nur Irfansyah
5	**Description of Course**	:	This course studies the implementation of digital circuits and systems using programmable hardware components of FPGA, which also include design procedures using HDL (Hardware Description Language) such as VHDL or Verilog, and the use of EDA tools for designing. Implementation includes design of combinational circuits, sequential circuits, FSM, DSP, digital filter circuit, and microprocessor design.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise (KU08) Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering digital circuits and systems for design and classification techniques, evolution of programmable H/W components, internal architecture of programmable H/W components such as PLD and FPGA and their respective advantages and disadvantages.

			Specific Skill Able to master the design stage of digital system based on H/W programmable ranging from the desired specification stage to testing stage, able to design a simple digital system based H/W programmable with the correct methodology, and able to understand the verification techniques and their usage. **General Skill** Able to understand the EDA tools as well as their usage, such as Quartus II for Altera FPGA and Xilinx ISE Able to design a digital system and implement in FPGA **Attitude** Demonstrating attitude of responsibility on work in his/her field of expertise independently
8	**Main Subjects**	:	1. Digital System: Combinational, Sequential, Controller, Data Path, Finite State Machine (FSM) 2. Evolution and Architecture of Programmed Hardware components: PROM, PAL, PLA, Masked Gate Array, FPGA 3. EDA Tools (Quartus Altera or Xilinx ISE): Editing, Test bench, Synthesis, Place and route, Programming tools 4. Technical design using HDL (VHDL or verilog), including Specification, component selection, system design, entity creation and architecture with logical/Boolean equation method, data flow and behavioral, verification: Simulation, Timing analysis, implementation and testing 5. Implementation of Combinational and Sequential Circuits of programmable component design into FPGA 6. Digital System Implementation and digital signal processing (Digital Filter) programmable component design into FPGA 7. Implementation of microprocessor (Control unit, datapath and memory) design of programmable components into FPGA
9	**Reference(s)**	:	[1] M Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, 2002 [2] Kevin Skahill, VHDL for Programmable Logic, Addison Wesley, 1996 [3] S. Brown and Z. Vranesic: Fundamentals of Digital Logic and VHDL Design, 3rd Edition McGraw-Hill, 2009. [4] Enoch O. Hwang, Digital Logic and Microprocessor Design with VHDL, CL-Engineering, 2006 atau 2016 yang terbaru. [5] M. Morris Mano and Charles R. Kimme, Logic and Computer Design Fundamentals, 4th edition, Pearson Prentice Hall, 2008.
10	**Prerequisite(s)**	:	Digital and Microprocessor Systems

Syllabus
Bachelor Program of Department of Electrical Engineering
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1	**Course Code and Name**	:	EE184644 Industrial Electronics and Robotics
2	**Credit(s)**	:	3
3	**Semester**	:	VI
4	**Lecturer(s)**	:	Djoko Purwanto, Suwito
5	**Description of Course**	:	In this course, students will study the concept of SCADA system in the industry along with its constituent components which include instrumentation system, controller and control strategy, drive system as well as electronic data communication network in industry. Students study industrial robotics systems that include the introduction and application of industrial robots, robotic kinematics, robot motion planning, industrial robot programming, robot control, and industrial robots in CIM (Computer Integrated Manufacture).
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of electronics systems on Supervisory Control and Data Acquisition (SCADA) systems and their constituent electronic devices, and mastering robotics systems in the industry. **Specific Skill** Able to design and analyze electronics system in Supervisory Control and Data Acquisition (SCADA) system and its electronic device, and able to implement robotics system in industry. **General Skill** Able to analyze and take decisions in solving problems related to electronics and robotics systems in the industry.

			Attitude Demonstrating attitude of responsibility on work in his/her field of expertise independently
8	**Main Subjects**	:	1. The concept of Supervisory Control and Data Acquisition (SCADA) systems and their constituent components. 2. Piping and instrumentation diagrams (P&ID) and engineering standards on electronic systems in the industry. 3. Electronics systems in the process of instrumentation and the driving system in the industry. 4. Electronic data communication system between SCADA system and communication protocol in industry. 5. Electronic systems in controlling devices and types of control strategies in the industry. 6. Programmable Logic Controller (PLC) 7. Planning and analysis of electronic systems on feedback control in the Industry. 8. Introduction and application of robots in industry 9. Kinematics of industrial robots 10. Industrial robot motion planning and industrial robot programming 11. Control of industrial robots and implementation of industrial robots in CIM (Computer Integrated Manufacture)
9	**Reference(s)**	:	[1] Timothy J. Maloney (2011). Modern IndustrialElectronics, 4/E, Prentice-Hall, Inc. [2] Bartelt, T. L. (2011). *Industrial automated systems: instrumentation and motion control*. Clifton Park, NY: Delmar. [3] Bruno Siciliano, dkk, Robotics: Modeling, Planning and Control, Springer-Verlag Limited, 2009. [4] Appin Knowledge Solution, Robotics, Infinity Science Press, 2007. [5] Lung-Wen Tsai, Robot Analysis, John Wiley and Sons, Inc., 1999.
10	**Prerequisite(s)**	:	Embedded Electronic System Sensors and Actuators

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1	**Course Code and Name**	:	EE184721 Digital Control and Automation Laboratory
2	**Credit(s)**	:	3
3	**Semester**	:	V
4	**Lecturer(s)**	:	Ir. Ali Fatoni, MT & Dr. Ir. Mochammad Rameli
5	**Description of Course**	:	These laboratory works provides practical understanding to the students about the forms of digital controller programming and the application of automation techniques in the industry, various digital programming & automation techniques in the industry, the principles of digital control & automation and various methods of ladder design in the field of automation, and instrumentation technology and process control.
6	**Learning Outcome**	:	**Knowledge** (PO2) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently (S12) Working together to be able to make the most of his/her potential
7	**Course Learning Outcome**	:	**Knowledge** Mastering the concepts and principles of Digital Control Mastering the concepts and principles of Automation System in Industry **Specific Skill** Be able to analyze and design Digital Control Be able to analyze and design Automation System in Industry

			Be able to provide consultation on the design and development of digital control and automation systems in the industry **General Skill** Be able to apply various digital controllers Be able to apply various design method of ladder diagram to Programmable Logix Controller (PLC) equipment Be able to apply system technology products and other settings **Attitude** Showing a responsible attitude towards the work in the field of expertise independently
8	**Main Subjects**	:	1. Practice on Sampling and Signal Reconstruction 2. Practice on Filtering Signals with Digital Filters 3. Practice on digital control programming for microcontroller on DC motor speed regulation system 4. Practice on digital control programming for PC on DC motor speed control system 5. Practice on ladder diagram programming based on sequence chart on PLC 6. Practice on ladder diagram programming based on cascade method on PLC 7. Practice on ladder diagram programming based on Grafchet on PLC 8. Practice on ladder diagram programming based on state diagram on PLC 9. Practice on ladder diagram programming based on Huffman method on PLC 10. Practice on ladder diagram programming based on Petri-Net on PLC
9	**Reference(s)**	:	[1] D. Pessen, Industrial Automation, Wiley, 1989 [2] S. Baranov, Logic Synthesis for Control Automata, Kluwer Academic Publisher, 1994 [3] Applying Structured Analysis To Automation Systems (Paper 1) [4] The Principles of State Logic Control (Paper 2) [5] Tadao Murata, Petri Nets: Properties, Analysis and Applications, Proceedings of the IEEE, vol.77, no 4, April 1989 (paper 3)
10	**Prerequisite(s)**	:	1. Digital Control Systems 2. System Automation

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1	**Course Code and Name**	:	EE184722 System Design and Integration
2	**Credit(s)**	:	3
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Team
5	**Description of Course**	:	This course discusses the design of a system by considering several aspects, evaluating a design result from several aspects, comparing several design results, determining the best design of all, and integrating the designs chosen in the form of uniform technological architecture. Next, implementing the technology architecture into the form of technology products that fulfill the needs.
6	**Learning Outcome**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics. (P04) Mastering the concepts, principles, and procedures which considers economical, social, and environment aspects in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. (KK04) Being able to implement alternative solutions of engineering problems in power systems, control systems, multimedia telecommunications, or electronics by concerning in factors of economy, public health and safety, culture, social, and environment (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics.

			General Skill (KU05) Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis (KU09) Being able to document, store, secure and recover data to ensure validity and prevent plagiarism **Attitude** (S05) Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others
7	**Course Learning Outcome**	:	**Knowledge** Concept and methodology of system design and integration **Specific Skill** Being able to integrate the design result of a system by combining technology, application, data and communication into a functional work structure with uniform technological architecture form. **General Skill** Being able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis. **Attitude** Contributing to improving the quality of life of society, nation, state, and civilization based on Pancasila.
8	**Main Subjects**	:	1. System Design Methodology 2. System Requirement Study 3. Conceptual Design 4. Functional Design 5. Detailed Design 6. System Testing 7. Decision Support System Design 8. System Integration 9. System Integration Components 10. System Implementation
9	**Reference(s)**	:	[1] Wasson, Charles S. *System Analysis, Design, and Development: Concepts, Principles, and Practices*. John Wiley & Sons, New Jersey, 2006 [2] Blanchard, B.S., W.J. Fabrycky. *Systems Engineering and Analysis*. 2nd edition, Prentice-Hall, New Jersey, 1992.. [3] Juric, Matjaz B., Ramesh Loganathan, Poornachandra Sarang, & Frank Jennings. *SOA Approach to Integration*. Packt Publishing, Birmingham, 2007 [4] Ruh, William A., Francis X. Maginnis, & William J. Brown. *Enterprise Application Integration*. John Wiley & Sons, Inc., 2001

			[5] Myerson, Judith M. *Enterprise Systems Integration*. CRC Press Company, 2002. [6] Miller, Thomas E., Daryle W. Berger. *Totally Integrated Enterprises*. Raytheon Professional Services LLC, 2001.
10	**Prerequisite(s)**	:	Passing 110 credits

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1	**Course Code and Name**	:	EE184741 Integrated Electronic Systems Lab.
2	**Credit(s)**	:	3
3	**Semester**	:	VII
4	**Lecturer(s)**	:	Muhammad Rivai, Ronny Mardiyanto, Fajar Budiman
5	**Description of Course**	:	The course of Integrated Electronics System Lab. discusses the analytical, simulating, practicum, and design process of Analog Electronic Systems including Linear & Non-Linear Amplifiers, Oscillators & Small Signal Rectifiers, DC to DC converters, Active Filters, Analog-Digital converters, and Field Programmable Analog Arrays; Embedded Electronics Systems; Design using Programmable Device include: hardware programming languages such as VHDL or Verilog, use of EDA tools for design, Implementation on FPGA that includes the design of combinational circuits, sequential circuits, FSM, DSP digital filter circuit and microprocessor design.
6	**Learning Outcomes**	:	**Knowledge** (P05) Mastering the factual knowledge about information and communication technology, and the latest technlogy and its applications in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU07) Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility **Attitude** (S12) Working together to be able to make the most of his/her potential
7	**Course Learning Outcomes**	:	**Knowledge** Mastering factual knowledge about the latest technology of analog and digital circuitry and its use in integrated electronics system. **Specific Skill** Able to utilize analytical and engineering tools based on appropriate analog and digital electronics technology in conducting engineering activities on integrated electronics systems. **General Skill** Able to be responsible for the achievement of group work that

			includes the process of analysis, simulation, practicum and design of integrated electronic systems. **Attitude** Working together to make the most of his/her potential concerning to the process of analysis, simulation, practicum and design of integrated electronic systems.
8	**Main Subjects**	:	1. Linear & Non-Linear Amplifiers 2. Oscillator & Small Signal Rectifier 3. DC to DC converters 4. Active Filter 5. Analog-Digital converter 6. Field Programmable Analog Array 7. Design of analog electronic systems 8. Embedded Electronics System 9. VHDL / Verilog and EDA Tools 10. Combinational circuit in FPGA 11. Sequential Circuits in FPGA 12. Face to face and display with FPGA 13. Digital Filters (FIR) in FPGA 14. Microprocessor in FPGA
9	**Reference(s)**	:	[1] Instructions of Integrated Electronic Systems Lab., 2018
10	**Prerequisite(s)**	:	Design of Analog Electronic Systems Embedded Electronic System Design Using Programmable Device

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1	**Course Code and Name**	:	EE184921 Adaptive Control Systems
2	**Credit(s)**	:	3 credits
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Ir. Ali Fatoni, MT
5	**Description of Course**	:	Adaptive Control System course discuss the concept of adaptive control systems, both direct (indirect), parametric model of dynamic systems, parameter estimation method, non-recursive parameter estimation and recursive parameter estimation, model validation, reference model adaptive system (MRAC), system adaptive self tuning regulator (STR) and fuzzy adaptive setting system.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU02) Being able to demonstrate independent performance, quality, and measurable **Attitude** (S11) Trying his/her best to achieve perfect results
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of an adaptive system in control system issues. **Specific Skill** Be able to formulate adaptive control issues and analyze and create simulation of adaptive control system. **General Skill** Be able to use Matlab / Simulink software to perform visualization of adaptive control.

			Attitude Trying his/her best in a teamwork to achieve perfect results
8	**Main Subjects**	:	1. The concept of adaptive control. 2. Parametric model system, parameter estimation, model validation. 3. Reference model adaptive system (MRAC) 4. Self-tuning adaptive system (STR) 5. Stochastic adaptive control system 6. The concept of adaptive system stability 7. Adaptive fuzzy control system
9	**Reference(s)**	:	[1] Astrom, KJ and Wittenmark, B.: "Adaptive Control", Addison-Wesley, 1997 [2] Landau, ID,: "System Identification and Control Design", Prentice-Hall, 1990 [3] Tao, Gang, : " Adaptive Control, Design and Analysis", John Wiley & Sons, 2003 [4] Sastry, S. and Bodson,M: "Adaptive Control Stabliity, Convergence and Robustness", Prentice-Hall, 1989
10	**Prerequisite(s)**	:	Introduction to Control Systems

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1	**Course Code and Name**	:	EE184923 Signal Processing for Control
2	**Credit(s)**	:	3
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Abdullah Alkaff
5	**Description of Course**	:	The signal processing for control course discusses methods of processing signals that are contaminated by interference and noise to obtain mathematical models, or also called system identification, the system that generates such signals. The models are discrete time linear system models and are used to estimate and predict the state of the system based on the identified model. The system models discussed are ARMA, ARMAX and ARIMA which are then used for estimation and prediction of state using Wiener filter and Kalman filter.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work **Attitude** (S11) Trying his/her best to achieve perfect results

7	**Course Learning Outcomes**	:	**Knowledge** the concept of modeling estimation using measurement data and the concept of state estimation for liner system. **Specific Skill** Capable of modeling dynamic system based on measurement data and using the model to make estimation of system state. **General Skill** Able to realize the process of identifying and estimating the state into the form of computer code. **Attitude**
8	**Main Subjects**	:	1. System identification 2. Discrete-time Wiener filter 3. Discrete-time Kalman filter 4. Winener dan Kalman filters applications
9	**Reference(s)**	:	[1] Alkaff, A. Diktat Kuliah Teknik Penyaringan Optimal [2] Candi, J.A., Model Based Signal Processing, Wiley-IEEE, 2006 [3] Brown, R.G. dan Y.C. Hwang, Introduction to Random Signals and Applied Kalman Filtering, 4th ed, Wiley, 2012 [4] Shanmugan, K.S. dan A. M. Breiphol, Random Signals: Estimation, Detection, and Data Analysis, Wiley, 1988 [5] Alkaff, A., Diktat Kuliah Proses Stokastik (atau yang baru)
10	**Prerequisite(s)**	:	Signals and Systems

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1	**Course Code and Name**	:	EE184924 Network Analysis
2	**Credit(s)**	:	3
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Yusuf Bilfaqih
5	**Description of Course**	:	Understanding the network; graph theory; graph and network representation; labeling procedures; the shortest path problem; variations and the shortest path application; the shortest path algorithm; spanning tree problems; variations, applications and spanning tree algorithms; maximum flow problems; variations, applications and maximum flow algorithms; transportation and transhipment issues; variations, applications and transportation and transhipment algorithms; minimum cost issues; variations, applications and minimum cost algorithms; generalizing the flow on the network and examples of its application; method of completion for one example of flow generalization; Bayesian network: its variations and its applications; as well as social networks: variations and their applications
6	**Learning Outcomes**	:	**Knowledge** (P02) Being able to demonstrate independent performance, quality, and measurable (P03) Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability.

			General Skill (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work **Attitude** (S03) Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of Network Optimization and its Application **Specific Skill** Being able to solve optimization problems using network optimization methods. **General Skill** Being able to use C / Java programming language to implement algorithm modeling and solving network problems. **Attitude** Contributing to improving the quality of life of society, nation, state, and civilization based on Pancasila.
8	**Main Subjects**	:	1. Graph Theory 2. Network Concepts & Representations 3. Shortest path 4. Spanning Tree 5. Maximum flow (maximum flow) 6. Transportation and Transhipment 7. Minimum Cost (minimum cost) 8. Flow Generalization on the Network 9. Bayesian Network 10. Social Networking
9	**Reference(s)**	:	[1] Bertsektas, Dimitri P. *Network Optimization: Continuous and Discrete Models*. Athena Scientific, Massachusetts, 1998. [2] Philips, D.T. *Fundamentals of Network Analysis*. Prentice-Hall, New Jersey, 1980. [3] Jensen, P.A. dan J.W.Barnes. *Network Flow Programming*. John Wiley & Sons Inc., New York 1980. [4] Ahuja, Ravindra K., Thomas L Magnanti, James B Orlin. *Network Flow Analysis*. Prentice-Hall, 1993 [5] Alkaff, Abdullah. *Diktat Analisa Jaringan*. Diktat Kuliah, TSP, JTE, 2000.
10	**Prerequisite(s)**	:	Linear Algebra

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1	**Course Code and Name**	:	EE184925 Multi-agent Systems
2	**Credit(s)**	:	3 credits
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Mochammad Sahal
5	**Description of Course**	:	The multi-agent systems course deals with the concepts of multi-agent systems: control and applications, static agreement protocols between agents, interagency dynamic agreement protocols, interagency agreements in random noise, inter agency formation control, inter agency cooperative control, information-based estimates derived from multi-agent, conflict between agents.
6	**Learning Outcomes**	:	**Knowledge** (P01) Mastering the concepts and principles of natural science and engineering mathematics and making it happen in the form of procedures necessary for analysis and design of power systems, regulatory systems, multimedia telecommunications, or electronics. (P02) Mastering the concepts, procedures and principles of engineering and making them happen in the form of procedures required for analysis and design of systems in the field of Electronics, Power System, Multimedia Telecommunication, and System Settings. (P03) Mastering the concepts, principles and procedures for designing electric power systems, regulatory systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Able to formulate engineering problems in the field of Electronics, Power Systems, Multimedia Telecommunications, and System Settings. (KK02) Able to describe the settlement of engineering problems on electrical power systems, regulatory systems, multimedia telecommunications, or electronics. **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and

			implements the value of humanities in accordance with their area of expertise. (KU02) Being able to demonstrate independent performance, quality, and measurable. (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work. **Attitude** (S09) Demonstrate responsible attitudes towards the work in the field of expertise independently. (S11) Trying his/her best to achieve perfect results. (S12) Working together to be able to make the most of his/her potential.
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the facts, concepts, procedures, and principles of multi-agent systems. **Specific Skill** Able to analyze protocol agreements, formation control, cooperative control, estimates of multi-agent information, conflicts among agents. **General Skill** Able to use Matlab / Simulink software to simulate protocol agreement, formation control, cooperative control, estimation of multi agent information, conflict between agent. **Attitude** Demonstrate a responsible attitude towards the work in the field of expertise independently. Working together to be able to take full advantage of their potential.
8	**Main Subjects**	:	1. The concept of multi-agent system: control and application 2. Static agreement protocol between agents 3. Dynamic agreement protocol between agents 4. Agreement among agents in random noise 5. Formation control between agents 6. Cooperative control between agents 7. Estimates based on information come from multi agents 8. Conflict between agents
9	**Reference(s)**	:	[1] Mehran Mesbahi, Magnus Egerstedt, "Graph Theoritic Methods in Multiagent Networks," 1st Edition, Princeton, New Jersey, 2010
10	**Prerequisite(s)**	:	--

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1	**Course Code and Name**	:	EE184926 Process Control Systems
2	**Credit(s)**	:	3 credits
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Ir. Ali Fatoni, MT
5	**Description of Course**	:	Process Control System course gives an introduction to the process system and its arrangement to the students of electrical engineering. In this course we present modeling of process systems for processes commonly used in industry. Methods of the model analysis are described to show the system behavior. The final part describes the controller design methods, among which are PID controllers that are widely used in industry.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work **Attitude** (S12) Working together to be able to make the most of his/her potential
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concepts and theories of analysis and design of process control system **Specific Skill** Be able to model, analyze, and design process control systems **General Skill** Be able to realize control system for process system using softwares **Attitude** Working in team to maximize possible possessed potential

8	**Main Subjects**	:	1. Introduction to Process Control System 2. Mathematical process model 3. Model based controller 4. Loop control 5. Conceptual design of Process Control System 6. Design the simulation of Process Control System 7. Design the implementation of Process Control System
9	**Reference(s)**	:	[1] Babatunde A. Ogunnaike, Process, Dynamics, Modeling and Control, 1994. [2] Wolfgang Altmann, "Practical Process Control for Engineers and Technicians," John Elsevier, 2005 [3] W.L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers," McGraw Hill, 2nd edition, 1990
10	**Prerequisite(s)**	:	Introduction to Control Systems

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1	**Course Code and Name**	:	EE184927 Control of Electric Drives
2	**Credit(s)**	:	3 credits
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Mochammad Rameli
5	**Description of Course**	:	This course discusses the latest control methods in electrical control systems, power transfer circuits (PWM Inverter 3 phase), brushless DC motor servo, speed and position controller, speed sensorless control, and makes software on electric drive system
6	**Learning Outcomes**	:	**Knowledge** (P01) Mastering the concepts and principles of science and engineering mathematics, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work. **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently. (S12) Working together to be able to make the most of his/her potential.
7	**Course Learning Outcomes**	:	**Knowledge** Ability to explain the dynamics of loaded motor system, how dc motor works, induction motor, voltage control method for AC inductor motor, synchronous motor work principle **Specific Skill** Able to dispose of rectifier control, chopper control, closed-loop control for dc drives, speed control and multiquadrant control, control using voltage source inverter, control using current source

			inverter, self control for synchronous motor **General Skill** Capable of designing rectifier control, chopper control, closed loop control for dc drives, speed control and multiquadrant control, control using voltage source inverter, control using current source inverter, self control for synchronous motor using MATLAB, microcontroller **Attitude**
8	**Main Subjects**	:	1. DC Motor Dynamics 2. Control of DC Motor 3. Induction Motor Dynamics 4. Control of Induction Motor 5. Control of Sync Motor
9	**Reference(s)**	:	[1] DUBEY, Gopal K : **Power Semiconductor Controlled Drives**, Prentice Hall, Inc., 1989 [2] Subrahmanyam, Vedam : **Electric Drives Concepts & Applications**, McGraw-Hill, 1996
10	**Prerequisite(s)**	:	Control System Analysis and Design

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1	**Course Code and Name**	:	EE184928 Robotics
2	**Credit(s)**	:	3
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	Achmad Jazidie
5	**Description of Course**	:	This course discusses the concept of robotics application in the field of industrial automation, and the application of current control methods to robotics in the field of industrial automation.
6	**Learning Outcomes**	:	**Knowledge** (P01) Mastering the concepts and principles of science and engineering mathematics, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK01) Being able to formulate engineering problems in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work. **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently. (S12) Working together to be able to make the most of his/her potential.
7	**Course Learning Outcomes**		**Knowledge** Students are able to analyze kinematics and robot dynamics **Specific Skill** **General Skill**

	Attitude		
8	**Main Subjects**	:	1. Coordinate Transformation 2. Kinematics Robot 3. Differential Motion 4. Robot Dynamics 5. Robotic Control
9	**Reference(s)**	:	[1] Mark W Spong, M Vibyasagar : "Robot Dynamics and Control", John Wiley & Sons, 1989 [2] H Asada, JJE Slotine : "Robot Analysis and Control", John Wiley & Sons, 1986
10	**Prerequisite(s)**	:	

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1	**Course Code and Name**	:	EE184929 Embedded Control Systems
2	**Credit(s)**	:	3
3	**Semester**	:	Elective
4	**Lecturer(s)**	:	
5	**Description of Course**	:	Embedded system course is a course that provides an introduction to control systems implemented on a microcontroller or system-on-chip. After explaining the concept and architecture of the embedded system, the modeling method of the embedded system is given. Analytical methods based on a given model which can then be designed for working embedded systems. Programming methods and practical applications become an integral part of this course.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts and principles of engineering, and implementing them in the form of procedures for analysis and design in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics. (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work **Attitude** (S11) Trying his/her best to achieve perfect results
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concepts and theory of embedded systems for control system applications. **Specific Skill** Able to perform analysis and design of microcontroller based control system. **General Skill**

			Able to perform embedded system implementation for control system using microcontroller. **Attitude** Trying to the fullest to achieve perfect results.
8	**Main Subjects**	:	1. Introduction to embedded systems and real-time systems 2. Embedded system models 3. Embedded system design 4. C programming for embedded systems 5. Embedded system development approachs 6. Scheduler 7. RTOS (Real Time Operating System) 8. Introduction to 32-bit ARM processor
9	**Reference(s)**	:	[1] David E. Simon, “An Embedded Software Primer”, Addison-Wesley, 1999 [2] Jean J. Labrosse, “MicroC/OS-II The Real-Time Kernel”, R&D Books, Lawrence, 1999 [3] Berger, Arnold, "Embedded Systems Design: An Introduction to Processes, Tools, and Techniques", CMP Books, Lawrence Kansas
10	**Prerequisite(s)**	:	Introduction to Control Systems

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1	**Course Code and Name**	:	EE184940 Basic Intelligent Electronic System
2	**Credit(s)**	:	3
3	**Semester**	:	VII
4	**Lecturer(s)**	:	Djoko Purwanto, Muhammad Attamimi
5	**Description of Course**	:	Basic Intelligent Electronic System course discusses the basic principles of components in intelligent systems such as machine learning (neural network, visual recognition), machine reasoning (fuzzy system), and optimization (genetic algorithm). In this lecture, the design of intelligent electronics systems for particular applications, and an implementation of intelligent systems in microcontroller-based embedded systems (e.g., raspberry pi, Arduino, and so forth), will also be studied.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics (P05) Mastering the factual knowledge about information and communication technology, and the latest technlogy and its applications in power systems, control systems, multimedia telecommunications, or electronics **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the basic principles of the components in an intelligent system.

			Specific Skill Being able to design and realize intelligent electronics systems for specific applications. **General Skill** Being able to use electronic devices and software to realize an intelligent system. **Attitude** Demonstrating attitude of responsibility on work in his/her field of expertsei independently.
8	**Main Subjects**	:	1. Fundamentals of neuroscience and neuron modeling, neural network feedforward model and feedback propagation. 2. Learning methods in neural network. 3. Topics on visual recognition. 4. Fuzzy logic and fuzzy inference system. 5. Genetic algorithm. 6. Design and implementation of intelligent electronics systems.
9	**Reference(s)**	:	[1] NK Bose, and P. Liang, "Neural Network Fundamental", McGraw Hill Inc., 1996. [2] Frederic M Hum, and Ivica Kostanic, "Principles of Neurocomputing for Science & Engineering", McGraw Hill Inc., 2001. [3] JSR Jang, CT Tsun, "Neuro-Fuzzy and Soft Computing", Prentice Hall Inc., 1997. [4] T. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 1995. [5] David B Fogel, "Evolutionary Computation", IEEE Press.
10	**Prerequisite(s)**	:	Numerical Methods

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1	**Course Code and Name**	:	EE184941 Optoelectronic Devices
2	**Credit(s)**	:	3
3	**Semester**	:	VIII
4	**Lecturer(s)**	:	Muhammad Rivai
5	**Description of Course**	:	The course of Optoelectronic Device discusses: The Properties of Light including Polarization, Interference, Diffraction, Light Spectrum, and Monochromator; Modulation of Light; Display Devices including Light Emitting Diode, Plasma Display, Liquid Crystal Display; Lasers including Laser Stimulation Techniques, Q-Switching; Photodetectors including Photocathode, UVTRON, Photomultiplier, Photoconductive, Photodiode, Photovoltaic, Charge-coupled Device; Optical Fibers including Fiber Dispersions, Multimode Step-index Fibers, Inter-modal Dispersion, Single-mode Fiber, Graded-index Fiber, Material Dispersion, Fiber Losses, Optical Time-Domain Reflector; Integrated Optics including Waveguide Fabrication, Directional Coupler, Splitter, Wavelength Multiplexer, Interferometric Filter, Optical Switch, Optical Amplifier; Optical Communication System; Applications of Optoelectronic Devices.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics **Specific Skill** (KK02) Being able to describe the completion of engineering problems in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concepts, principles of design procedure for optoelectronic device technology systems and its applications in telecommunications or electronics. **Specific Skill** Being able to describe the analysis, simulation, design, and application of optoelectronic devices.

			General Skill Being able to apply the analysis, simulation, design, and application of optoelectronic devices. **Attitude** Demonstrating attitude of responsibility regarding the analysis, simulation, design, and application of optoelectronic devices independently.
8	**Main Subjects**	:	1. The Properties of Light 2. Modulation of Light 3. Display Devices 4. Lasers 5. Photodetectors 6. Optical Fibers 7. Integrated Optics 8. Optical Communication System 9. Applications of Optoelectronic Devices
9	**Reference(s)**	:	[1] Muhammad Rivai, 2018. Lecture Note: Optoelectronic Devices [2] S.O. Kasap, 2012. Optoelectronics & Photonics: Principles & Practices, Prentice Hall
10	**Prerequisite(s)**	:	Electromagnetic Field

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1	**Course Code and Name**	:	EE184942 Electronic Control System
2	**Credit(s)**	:	3
3	**Semester**	:	VII or VIII (Elective Course)
4	**Lecturer(s)**	:	Djoko Purwanto
5	**Description of Course**	:	Electronic control system discusses electronics control system design methods and their implementations both analog and digital. Control system design methods include classical and modern methods. The identification system to obtain the plant model to be used in control system design is also discussed in this course. The implementations of analog control system are done by using op-amp circuit. The implementations of digital control system are done by microcomputer (personal computer and microcontroller).
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics. (P05) Mastering the factual knowledge about information and communication technology, and the latest technology and its applications in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of design and implementation of electronic control systems either analog or digital.

			Specific Skill Able to design and implement analog electronic control system based on op-amp circuit and digital control system based on microcomputer. **General Skill** Able to complete the design and implementation of electronic systems for specific applications. Able to use ICT devices to design electronics systems and devices to implement the system. **Attitude** Demonstrating self-reliance, creative, and innovative in problem solving
8	**Main Subjects**	:	1. Basic design of control system 2. Design of PID control system 3. Design of fuzzy logic control system 4. Implementation of identification system 5. Design of control system with linear algebra method 6. System design with interference observation method 7. Implementation of analog control system 8. Implementation of digital control system
9	**Reference(s)**	:	[1] Cheng Siong Chin, Computer-Aided Control Systems Design, CRC Press, 2013. [2] Jan Jantzen, Foundations of Fuzzy Control: a Practical Approach (2nd Edition), John Wiley & Sons, 2013. [3] Ioan D. Landau and Gianluca Zito, Digital Control Systems: Design, Identification and Implementation, Springer-Verlag, 2006. [4] Dogan Ibrahim, Microcontroller-Based Applied Digital Control, John Wiley & Sons, 2006. [5] Chi-Tsong Chen, Analog and Digital Control System Design, Saunders College Publishing, 2005.
10	**Prerequisite(s)**	:	Introduction to Control Systems

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1	**Course Code and Name**	:	EE184943 Electronic Instrumentation
2	**Credit(s)**	:	3
3	**Semester**	:	VII or VIII (Elective Course)
4	**Lecturer(s)**	:	Suwito
5	**Description of Course**	:	Electronic Instrumentation course discusses the working principle of electronic systems applied to home appliances and automotive. Home appliances topics include radio transmitters and receivers, television transmitters and receivers, Air conditioning (AC) and multimedia devices. In the field of automotive, the topics include Capacitor Discharge Ignition (CDI), Electronic Fuel Injection (EFI) and Electric Car.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. **General Skill** (KU05) Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Able to explain the basic concepts of electronics systems applied to home appliances and automotive. **Specific Skill** Able to analyze the specifications and problems in electronic systems applied to household devices and automotive. **General Skill** Able to make decisions in the selection of electronic products on home appliances and automotive. **Attitude** Demonstrating attitude of responsibility on work in his/her field of expertise independently in term of Electronic Instrumentation

8	**Main Subjects**	:	1. History of radio technology development. 2. The working principle of radio transmitter. 3. The working principle of the radio receiver. 4. Types of radio. 5. The working principle of television receiver. 6. Types of television 7. The working principle of dvd and audio amplifier. 8. The working principle of air conditioning (ac) 9. Types of AC 10. System of CDI on automotive. 11. EFFI system on automotive 12. Electric car system.
9	**Reference(s)**	:	[1] Fischer, W. (2008). Digital Video and Audio Broadcasting Technology A Practical Engineering Guide. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg.
10	**Prerequisite(s)**	:	Electronic Circuits

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1	**Course Code and Name**	:	EE184944 Machine Vision
2	**Credit(s)**	:	3
3	**Semester**	:	VII
4	**Lecturer(s)**	:	Ronny Mardiyanto
5	**Description of Course**	:	This course studies the visual sensing of electronics (visual perception of an image) using a camera that includes image acquisition techniques with cameras, image processing, image analysis, and image-based understanding of on chip system devices (Raspberry Pi). The common applications widely used to create object separators by color, facial recognition, vehicle counters, moving objects detection and others.
6	**Learning Outcomes**	:	**Knowledge** (P04) Mastering the concepts, principles, and procedures which considers economical, social, and environment aspects in power systems, control systems, multimedia telecommunications, or electronics. (P05) Mastering the factual knowledge about information and communication technology, and the latest technology and its applications in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK04) Being able to implement alternative solutions of engineering problems in power systems, control systems, multimedia telecommunications, or electronics by concerning in factors of economy, public health and safety, culture, social, and environment (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics **General Skill** (KU12) Being able to implement information and communication technology (ICT) in the context of implementation of his/her work (KU13) Being able to apply entrepreneurship and understand technology-based entrepreneurship **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently (S10) Internalizing spirit of independence, struggle and entrepreneurship (S11) Trying his/her best to achieve perfect results (S12) Working together to be able to make the most of his/her

			potential
7	**Course Learning Outcomes**	:	**Knowledge** Understand the technique of image acquisition, segmentation, recognition, image understanding, and hardware used in machine vision. **Specific Skill** Mastering the technique of image acquisition, segmentation, recognition, image understanding, and hardware used in machine vision. **General Skill** Able to use Visual Studio, OpenCv Library **Attitude** Able to internalize the spirit of independence, struggle, and entrepreneurship
8	**Main Subjects**	:	1. Introduction of machine vision 2. Device used for machine vision 3. Binary Image Processing: (1) Threshold, (2) Adaptive Threshold, (3) Histogram, (4) Edge Detection, (5) Blob Analysis, (6) Image Compression, (7) Background Subtraction, (8) Filter, (9) Contour 4. Features: (1) Edge, (2) Corner, (3) Points 5. Template Matching: (1) SAD, (2) SSD, (3) Cross Correlation, (4) Cross Correlation Coefficient 6. Motion Analysis, Mean Shift 7. Pattern Analysis, PCA, Gabor Filter, LBP, Viola Jones
9	**Reference(s)**	:	[1] Buku Ajar Penginderaan Visual Elektronika, Ronny Mardiyanto, 2018 [2] Linda G. Shapiro, Computer Vision, Prentice-Hall, Inc., 2001 [3] Milan Sonka dkk, Image Processing: Analysis, and Machine Vision, Brooks and Cole Publishing, 1998. [4] Ramesh Jain, Machine Vision, McGraw-Hill, Inc., 1995 [5] Gary Bradski and Adrian Kaehler, Learning OpenCV: Computer Vision with OpenCV Library, O'Reilly Media, Inc., 2008
10	**Prerequisite(s)**	:	Numerical Method

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1	**Course Code and Name**	:	EE184945 Autonomous Robot System
2	**Credit(s)**	:	3
3	**Semester**	:	VII or VIII (Elective Course)
4	**Lecturer(s)**	:	Djoko Purwanto
5	**Description of Course**	:	Autonomous robot systems learn about manipulators, mobile robots, autonomous flying robots, and autonomous surface vessels. In the manipulators, students study about redundant and hyper-redundant manipulators and their control techniques. In the mobile robot, students study about the model, trajectory-tracking control, formation control, motion planning, and navigation. In mobile robot, students also study about autonomous flying robot, and autonomous surface vessel.
6	**Learning Outcomes**	:	**Knowledge** (P03) Mastering the concepts and principles of design procedure in power systems, control systems, multimedia telecommunications, or electronics. (P05) Mastering the factual knowledge about information and communication technology, and the latest technology and its applications in power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK03) Being able to describe system design for problem solving in power systems, control systems, multimedia telecommunications, or electronics by concerning technical standards, performace aspect, reliability, ease of application, and assurance of sustainability. (KK05) Being able to utilize analytical and engineering design tools based on appropriate information and computation technology to perform engineering activities in power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU01) Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise **Attitude** (S09) Demonstrating attitude of responsibility on work in his/her field of expertise independently
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of autonomous robot and its application **Specific Skill**

			Able to understand the concept of autonomous robots in the form of manipulators, mobile robot, autonomous flying robot, and autonomous surface vessel **General Skill** Able to design autonomous robotic systems for specific applications. **Attitude** Demonstrating self-reliance, creative, and innovative in problem solving
8	**Main Subjects**	:	1. Autonomous Robot System 2. Manipulators 3. Mobile robot 4. Autonomous flying robot 5. Autonomous Surface vessel
9	**Reference(s)**	:	[1] Lounis Adouane, Autonomous Vehicle Navigation: From Behavioral to Hybrid Multi-Controller Architectures, Taylor & Francis Group LLC, 2016. [2] Farbod Fahimi, Autonomous Robots: Modeling, Path Planning, and Control, Springer Science+Business Media LLC, 2009. [3] Kenzo Nonami, Farid Kendoul, Satoshi Suzuki, Wei Wang, Daisuke Nakazawa, Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles, Springer-Verlag, 2006.
10	**Prerequisite(s)**	:	Digital and Microprocessor Systems Introduction to Control Systems

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1	**Course Code and Name**	:	EW184201 Electric Circuits
2	**Credit(s)**	:	2 SKS
3	**Semester**	:	II (Two)
4	**Lecturer(s)**	:	Totok Mujiono, Djoko Purwanto, Hendra Kusuma, Fajar Budiman
5	**Description of Course**	:	Electric Circuit course discusses the basic concepts of the electric circuit and its analysis. The course including two basic laws of the circuit (Ohm's Law and Kirchhoff's Law), two methods of analysis (nodes and mesh), some useful circuit methods (superposition theorem, thevenin equivalent circuit, Norton equivalent circuits, and maximum power transfer). The next topic of discussion is the principle of capacitors and inductors, responses of circuits with capacitor or inductor (first order circuit), and responses of circuit with resistor, capacitor and inductor (second order circuit) in both series and parallel circuits.
6	**Learning Outcomes**	:	**Knowledge** (P02) Mastering the concepts, procedures and principles of engineering and making them possible in the form of procedures necessary for the analysis and design of systems in the field of power systems, control systems, multimedia telecommunications, or electronics. **Specific Skill** (KK02) Able to describe the engineering problem solving procedures in the field of power systems, control systems, multimedia telecommunications, or electronics. **General Skill** (KU01) Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that considering the value of humanities appropriate to its area of expertise. **Attitude** (S09) Demonstrate a responsible attitude towards the work in the field of his/her expertise independently.
7	**Course Learning Outcomes**	:	**Knowledge** Mastering the concept of electric circuits and its analysis for the purpose of analysis and system design in the field of electrical technology. **Specific Skill** Able to describe the procedure of electric circuit analysis in the field of electrical technology.

			General Skill Able to apply logical, critical, systematic, and innovative thinking in electric circuit and its analysis to the context of the development or implementation of science and technology considering the humanities value appropriate to his/her area of expertise. **Attitude** Demonstrate responsible attitude toward the work in his/her own field of expertise related to electrical circuitry.
8	**Main Subjects**	:	1. Electric circuits and circuit laws. 2. Basic Nodal and Mesh analysis 3. Useful circuit analysis technique. 4. Capacitor, inductor, and first order circuits. 5. The RLC circuits.
9	**Reference(s)**	:	[1] Electric Circuits, Lecture Notes. [2] Pujiono, Rangkaian Listrik, Graha Ilmu, 2010. [3] WH Hayt, JE Kemmerly, and SM Durbin, Engineering Circuit Analysis, McGraw Hill, 8th Edition, 2007. [4] CK Aexander and MNO Sadiku, Fundamental of Electric Circuit, McGraw Hill, 8th Edition, 2013.
10	**Prerequisite(s)**	:	Mathematics I