




MODULE HANDBOOK FUNDAMENTALS OF MICROCONTROLLERS AND MICROPROCESSORS







**BACHELOR DEGREE PROGRAM
DEPARTMENT OF BIOMEDICAL ENGINEERING
FACULTY OF INTELLIGENT ELECTRICAL AND INFORMATICS
TECHNOLOGY**

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

ENDORSEMENT PAGE

	<p>MODULE HANDBOOK Fundamentals of Microcontrollers and Microprocessors DEPARTMENT OF BIOMEDICAL ENGINEERING INSTITUT TEKNOLOGI SEPULUH NOPEMBER Number : 6852/IT2.IX.5.1.2/B/PP.03.00.00/2023</p>
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Proses Process	Penanggung Jawab Person in Charge			Tanggal Date
	Nama Name	Jabatan Position	Tandatangan Signature	
Perumus <i>Preparation</i>	Dr. Rachmad Setiawan, S.T., M.T.	Dosen <i>Lecturer</i>		November 18, 2022
Pemeriksa dan Pengendalian <i>Review and Control</i>	Dr. Tri Arief Sardjono, S.T., M.T.	Tim kurikulum <i>Curriculum team</i>		November 20, 2022
Persetujuan <i>Approval</i>	Dr. Rachmad Setiawan, S.T., M.T.	Koordinator RMK <i>Course Cluster Coordinator</i>		April 13, 2023
Penetapan <i>Determination</i>	Dr. Achmad Arifin, S.T., M.Eng.	Kepala Departemen <i>Head of Department</i>		April 17, 2023

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MODULE HANDBOOK


FUNDAMENTALS OF MICROCONTROLLERS AND MICROPROCESSORS

Module name	Fundamentals of Microcontrollers and Microprocessors	
Module level	Undergraduate	
Code	EB234401	
Course (if applicable)	Fundamentals of Microcontrollers and Microprocessors	
Semester	First Semester (Gasal)	
Person responsible for the module	Dr. Rachmad Setiawan, S.T., M.T.	
Lecturer		
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, mandatory , 5 th semester.	
Type of teaching, contact hours	Lectures, <60 students	
Workload	<ol style="list-style-type: none"> 1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 180 minutes (3 hours) per week. 	
Credit points	3 credit points (sks)	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites		
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO 1: Students are able to understand and explain the basic concepts of microcontroller and microprocessor hardware design.	PLO-06

	<p>CLO 2: Students are able to understand and explain the basic concepts of microcontrollers and types of microcontrollers.</p> <p>CLO 3: Students are able to understand and explain programming techniques on microcontrollers.</p> <p>CLO 4: Students are able to understand and explain the features and peripherals of the microcontroller, the interface and data communication on the microcontroller and its applications.</p> <p>CLO 5: Students are able to understand and explain about analog to digital converter (ADC) and digital to analog converter (DAC) and their applications.</p> <p>CLO 6: Students are able to design and realize electronic systems, especially microcontroller-based medical devices with the correct design method.</p>	<p>PLO-06</p> <p>PLO-06</p> <p>PLO-07</p> <p>PLO-07</p> <p>PLO-03</p>
Content	<p>The Fundamentals of Microcontrollers and Microprocessors course is a compulsory course that discusses the basics of microprocessors and microcontrollers. This course aims to make students understand basic knowledge about how hardware and software components are designed and organized into a system that works as a computer and are able to analyze and design a microprocessor and microcontroller-based digital system. With this understanding, students are expected to be able to apply it, especially in biomedical disciplines.</p>	
Study and examination requirements and forms of examination	<ul style="list-style-type: none"> • In-class exercises • Assignment 1, 2, 3, 4, 5, 6, 7 • Mid-term examination • Final project • Final examination 	
Media employed	<p>LCD, whiteboard, websites (myITS Classroom), zoom.</p>	
Reading list	<ol style="list-style-type: none"> 1. William Stallings, "Computer Organization and Architecture Designing for Performance, 8th Edition", Prentice Hall, New Jersey, 2010 2. M. Morris Mano, "Computer System Architecture, 3rd Edition", Prentice Hall, 1993 3. Barry B. Brey, "8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-Bit Extensions: Architecture, Programming, and Interfacing, Eighth Edition", Pearson Prentice Hall, New Jersey, 2009 4. Rachmad Setiawan, "Mikrokontroler MCS51", Graha Ilmu, 2006 5. Kenneth J. Ayala, "The 8051 Microcontroller: Architecture, 	

	Programming, and Applications”, West Publishing Company, St. Paul, 1991
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I. Rencana Pembelajaran Semester / Semester Learning Plan

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FAKULTAS TEKNOLOGI ELEKTRO DAN INFORMATIKA CERDAS DEPARTEMEN TEKNIK BIOMEDIK				Kode Dokumen
		RENCANA PEMBELAJARAN SEMESTER				
MATA KULIAH (MK) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>CREDITS</i>		SEMESTER	Tgl Penyusunan <i>Compilation Date</i>
Fundamentals of Microcontrollers and Microprocessors	EB234401	Teknik Biomedik <i>Biomedical Engineering</i>	T=3	P=0	V	Feb 27, 2023
OTORISASI / PENGESAHAN <i>AUTHORIZATION / ENDORSEMENT</i>	Dosen Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i> (Nada Fitriyatul H, S.T, M.T)		Koordinator RMK <i>Course Cluster Coordinator</i> (Dr. Rachmad Setiawan, S.T., M.T.)		Ka DEPARTEMEN <i>Head of Department</i> (Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to The Course</i>					
<i>Learning Outcomes</i>	CPL-03 PLO-03	Mampu merancang dan melaksanakan eksperimen laboratorium dan/atau lapangan, menganalisa dan menginterpretasi data, serta menggunakan penilaian yang obyektif untuk menarik kesimpulan Able to design and implement laboratory experiment and/or field experiments, analyze and interpret data, and use objective assessments to draw conclusions				
<i>Learning Outcomes</i>	CPL-06 PLO-06	Mampu menerapkan ilmu pengetahuan, keterampilan, dan metode terkini dalam menyelesaikan permasalahan di bidang Teknik Biomedika. Able to apply the latest knowledge, skills and methods in solving problems in the field of Biomedical Engineering				
<i>Learning Outcomes</i>	CPL-07 PLO-07	Mampu merencanakan , menyelesaikan , dan mengevaluasi tugas di dalam batasan-batasan yang ada Able to plan , complete , and evaluate tasks within existing boundaries				

<p>Capaian Pembelajaran Mata Kuliah (CPMK) – Bila CP MK sebagai kemampuan pada tiap tahap pembelajaran CP MK = Sub CP MK Course Learning Outcome (CLO) - If CLO as description capability of each Learning Stage in the course, then CLO = LLO</p>	
<p>CP MK 1</p> <p>CLO 1</p>	<p>Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikroprosesor dan perancangan perangkat keras mikroprosesor.</p> <p><i>Students are able to understand and explain the basic concepts of microprocessors and microprocessor hardware design.</i></p>
<p>CP MK 2</p> <p>CLO 2</p>	<p>Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikrokontroler dan tipe-tipe mikrokontroler.</p> <p><i>Students are able to understand and explain the basic concepts of microcontrollers and types of microcontrollers.</i></p>
<p>CP MK 3</p> <p>CLO 3</p>	<p>Mahasiswa mampu memahami dan menjelaskan tentang teknik pemrograman pada mikrokontroler.</p> <p><i>Students are able to understand and explain programming techniques on microcontrollers.</i></p>
<p>CP MK 4</p> <p>CLO 4</p>	<p>Mahasiswa mampu memahami dan menjelaskan tentang fitur dan peripheral mikrokontroler, antarmuka dan komunikasi data pada mikrokontroler serta penerapannya.</p> <p><i>Students are able to understand and explain the features and peripherals of the microcontroller, the interface and data communication on the microcontroller and its applications.</i></p>
<p>CP MK 5</p> <p>CLO 5</p>	<p>Mahasiswa mampu memahami dan menjelaskan tentang analog to digital converter (ADC) dan digital to analog converter (DAC) serta penerapannya.</p> <p><i>Students are able to understand and explain about analog to digital converter (ADC) and digital to analog converter (DAC) and their applications.</i></p>
<p>CP MK 6</p> <p>CLO 6</p>	<p>Mahasiswa mampu melakukan perancangan dan merealisasikan sistem elektronika khususnya peralatan medis berbasis mikrokontroler dengan metode perancangan yang benar.</p> <p><i>Students are able to design and realize electronic systems, especially microcontroller-based medical devices with the correct design method.</i></p>

Peta CPL – CP MK		CPL-01	CPL-02	CPL-03	CPL-04	CPL-05	CPL-06	CPL-07	CPL-08	CPL-09	CPL-10	CPL-11	CPL-12
Map of PLO - CLO	CPMK 1 / SUB CPMK 1 <i>CLO 1 / LLO 1</i>						√						
	CPMK 2 / SUB CPMK 2 <i>CLO 2 / LLO 2</i>						√						
	CPMK 3 / SUB CPMK 3 <i>CLO 3 / LLO 3</i>						√						
	CPMK 4 / SUB CPMK 4 <i>CLO 4 / LLO 4</i>							√					
	CPMK 5 / SUB CPMK 5 <i>CLO 5 / LLO 5</i>							√					
	CPMK 6 / SUB CPMK 6 <i>CLO 6 / LLO 6</i>			√									
	Deskripsi Singkat MK Short Description of Course	<p>Mata kuliah Dasar Mikroprosesor dan Mikrokontroler merupakan mata kuliah wajib yang membahas tentang dasar-dasar mikroprosesor dan mikrokontroler. Mata kuliah ini bertujuan agar mahasiswa memahami pengetahuan dasar tentang bagaimana komponen hardware dan software dirancang dan diorganisir menjadi suatu sistem yang bekerja sebagai komputer serta mampu menganalisa dan merancang sistem digital berbasis mikroprosesor dan mikrokontroler. Dengan pemahaman tersebut, mahasiswa diharapkan mampu menerapkannya terutama pada disiplin ilmu biomedik.</p> <p><i>The Fundamentals of Microcontrollers and Microprocessors course is a compulsory course that discusses the basics of microprocessors and microcontrollers. This course aims to make students understand basic knowledge about how hardware and software components are designed and organized into a system that works as a computer and are able to analyze and design a microprocessor and microcontroller-based digital system. With</i></p>											

	<i>this understanding, students are expected to be able to apply it, especially in biomedical disciplines.</i>
Bahan Kajian: Materi pembelajaran Course Materials:	<ol style="list-style-type: none"> 1. Pengenalan arsitektur mikroprosesor / <i>Introduction to microprocessor architecture</i> 2. Pengenalan konsep memori, register dan operasi register, input/output, sistem pengalamatan bus, dan bahasa assembly / <i>Introduction to memory, registers and register operations, input/output, bus addressing systems, and assembly language</i> 3. Pengenalan fitur dan peripheral mikrokontroler / <i>Introduction to the features and peripherals of the microcontroller</i> 4. Antarmuka dan komunikasi data UART, I2C dan One Wire pada mikrokontroler / <i>Interface and data communication with UART, I2C and One Wire in microcontroller</i> 5. Akses dan Pengalamatan input output / <i>Input output access and addressing.</i> 6. Teknik pemrograman display 7 segment, LCD dan OLED / <i>7 segment, LCD and OLED display programming techniques.</i> 7. Pengenalan ADC dan DAC / <i>Introduction to ADC and DAC</i> 8. Antarmuka Sensor / <i>Sensor interfacing</i> 9. Pemrograman Interrupt / <i>Interrupt programming</i>
Pustaka References	Utama / Main : <ol style="list-style-type: none"> 1. 1. William Stallings, “Computer Organization and Architecture Designing for Performance, 8th Edition”, Prentice Hall, New Jersey, 2010 2. M. Morris Mano, “Computer System Architecture, 3rd Edition”, Prentice Hall, 1993 3. Barry B. Brey, ”8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-Bit Extensions: Architecture, Programming, and Interfacing, Eighth Edition”, Pearson Prentice Hall, New Jersey, 2009 4. Rachmad Setiawan, “Mikrokontroler MCS51”, Graha Ilmu, 2006 5. Kenneth J. Ayala, “The 8051 Microcontroller: Architecture, Programming, and Applications”, West Publishing Company, St. Paul, 1991
Dosen Pengampu Lecturers	Dr. Rachmad Setiawan, S.T., M.T.

Mata kuliah syarat	
<i>Prerequisite</i>	

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; <i>[Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran <i>[Pustaka] / Learning Material [Reference]</i>	Bobot Penilaian (%) / Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 - 2	<p>Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikroprosesor dan perancangan perangkat keras mikroprosesor.</p> <p><i>Students are able to understand and explain the basic concepts of microprocessors and microprocessor hardware design.</i></p>	<ul style="list-style-type: none"> Mampu mendefinisikan konsep dasar, struktur dan cara kerja dari mikroprosesor seperti arsitektur sistem bus Mampu memahami pengenalan bahasa c, teknik pemrograman dan pengalamatan <ul style="list-style-type: none"> <i>Able to define basic concepts, structure and workings of microprocessors</i> <i>Able to understand the introduction of c language, programming</i> 	<p>Diskusi dan tanya jawab.</p> <p>Non-tes: Tugas 1: Mengetahui konsep dasar dan perancangan perangkat keras mikroprosesor (Tugas Tertulis)</p> <p><i>Discussion and questions and answers.</i></p> <p>Non-test: Task 1: <i>Regarding the basic concepts and design of microprocessor hardware (Written</i></p>	<ul style="list-style-type: none"> Kuliah, diskusi, tanya jawab, tugas [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] <i>Lecture, discussion, question and answer, exercise and assignment</i> [FF : 2 x 50"] [SA : 2 x 50"] [SS : 2 x 50"] 	<ul style="list-style-type: none"> Chatting dan diskusi dalam forum platform ITS <i>Chat and discussion in ITS platform forum.</i> 	<ul style="list-style-type: none"> Kontrak kuliah: - Motivasi belajar - Rencana pembelajaran - Aturan-aturan perkuliahan - Tujuan perkuliahan - Sistem penilaian, buku ajar/sumber pustaka Konsep dasar, struktur dan cara kerja dari mikroprosesor seperti: - Arsitektur sistem bus (address bus, data bus, dan control bus) - Memori 	5

		<i>techniques and addressing</i>	<i>Task)</i>			<ul style="list-style-type: none"> - Aritmatic logic unit - Register dan operasinya - Sinyal kontrol - Input-output - Timer - Interrupt • Pengenalan bahasa pemrograman, teknik pemrograman dan pengalamatan • <i>Course contract:</i> <ul style="list-style-type: none"> - <i>Motivation to learn</i> - <i>Lesson plan</i> - <i>Lecture rules</i> - <i>Course objective</i> - <i>Assessment system, textbooks / library resources</i> • <i>The basic concept, structure and workings of the microprocessor such as:</i> <ul style="list-style-type: none"> - <i>Bus system architecture</i> 	
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						<p>(bus address, bus data, and bus control)</p> <ul style="list-style-type: none"> - Memory - Arithmetic logic unit - Registers and their operations - Control signal - Input-output - Timer - Interrupt <ul style="list-style-type: none"> • Introduction to programming language, programming techniques and addressing 	
3	<p>Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikrokontroler dan tipe-tipe mikrokontroler.</p> <p><i>Students are able to understand and explain the basic concepts of</i></p>	<ul style="list-style-type: none"> • Mampu menjelaskan sejarah perkembangan mikroprosesor menuju mikrokontroler • Mampu memahami konsep dasar, struktur dan cara kerja dari mikrokontroler seperti arsitektur 	<p>Non-tes: Tugas 2: Mengenai konsep dasar, struktur dan cara kerja dari mikrokontroler (Tugas Tertulis)</p> <p>Non-test:</p>	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas <p>[TM : 1 x 50"] [BM : 1 x 50"] [PT : 1 x 50"]</p> <ul style="list-style-type: none"> • Lecture, 	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom • Lecture, discussion, question and 	<ul style="list-style-type: none"> • Sejarah perkembangan mikroprosesor menuju mikrokontroler • Konsep dasar, struktur dan cara kerja dari mikrokontroler 	5

	<p><i>microcontrollers and types of microcontrollers.</i></p>	<p>sistem bus (address bus, data bus, dan control bus), memori, register dan operasinya,</p> <ul style="list-style-type: none"> • Mampu menjelaskan tipe-tipe mikrokontroler (MCS51, AVR, ARM 32bit) • <i>Able to explain the history of the development of microprocessors to microcontrollers</i> • <i>Able to understand the basic concepts, structure and workings of a microcontroller such as the bus system architecture (address bus, data bus, and control bus), memory, registers and operations,</i> • <i>Able to explain the types of microcontrollers (MCS51, AVR, ARM 32bit)</i> 	<p>Task 2: <i>Regarding the basic concepts, structure and workings of a microcontroller (Written Task)</i></p>	<p><i>discussion, question and answer, exercise and assignment</i></p> <p>[FF : 1 x 50"] [SA : 1 x 50"] [SS : 1 x 50"]</p>	<p><i>answer, exercise and assignment in myITS Classroom platform</i></p>	<p>seperti:</p> <ul style="list-style-type: none"> - Arsitektur sistem bus (address bus, data bus, dan control bus) - Memori, - Register dan operasinya <ul style="list-style-type: none"> • Tipe-tipe mikrokontroler (MCS51, AVR, ARM 32bit) • <i>The history of the development of the microprocessor to the microcontroller</i> • <i>The basic concept, structure and workings of a microcontroller such as:</i> <ul style="list-style-type: none"> - <i>Bus system architecture (bus address, bus data, and bus control)</i> - <i>Memory</i> - <i>Registers and their</i> 	
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						<i>operations</i> <ul style="list-style-type: none"> • <i>Types of microcontrollers (MCS51, AVR, ARM 32bit)</i> 	
4 - 5	<p>Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikrokontroller dan tipe-tipe mikrokontroler.</p> <p><i>Students are able to understand and explain the basic concepts of types of microcontrollers.</i></p>	<ul style="list-style-type: none"> • Mampu memahami pengenalan bahasa pemrograman (bahasa c) pada mikrokontroller • Mampu menjalankan software editor, compiler dan simulator • Mampu menjelaskan dan mengaplikasikan teknik pemrograman dan pengalamatan • <i>Able to understand the introduction of programming language (c language) on microcontrollers</i> • <i>Able to run editor, compiler and simulator software</i> • <i>Able to explain and apply programming and addressing</i> 	<p>Non-tes: Tugas 3: Mengenai teknik pemrograman pada mikrokontroller (Tugas Tertulis)</p> <p>Non-test: Task 3: Regarding programming techniques on the microcontroller (Written Task)</p>		<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom • <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i> 	<ul style="list-style-type: none"> • Pengenalan bahasa pemrograman (bahasa c) pada mikrokontroller • Software editor dan compiler • Simulator • Teknik pemrograman dan pengalamatan • <i>Introduction to programming languages (C language) on the microcontroller</i> • <i>Editor and compiler software</i> • <i>Simulator</i> • <i>Programming and addressing techniques</i> 	5

		<i>techniques</i>					
6 – 7	<p>Mahasiswa mampu memahami dan menjelaskan tentang fitur dan peripheral mikrokontroler, antarmuka dan komunikasi data pada mikrokontroler serta penerapannya.</p> <p><i>Students are able to understand and explain the features and peripherals of the microcontroller, the interface and data communication on the microcontroller and its applications.</i></p>	<ul style="list-style-type: none"> • Mampu memahami pengenalan fitur dan peripheral mikrokontroler (timer, counter, interrupt, PWM, I2C, SPI, USART, CAN, dan lain-lain) • Mampu melakukan metode perancangan antarmuka dan komunikasi data mikrokontroler, penggunaan input dan output dasar (push button, dipswitch, keypad, LED, LCD dan lain-lain), komunikasi serial, komunikasi wire dan wireless • Mampu menjelaskan contoh-contoh rangkaian aplikasi antarmuka dan komunikasi data serta pemogramannya • <i>Able to understand the introduction of microcontroller features and</i> 	<p>Non-tes : Tugas 4: Mengenai fitur dan peripheral mikrokontroler (Tugas Tertulis)</p> <p>Tugas 5: Perancangan aplikasi antarmuka dan komunikasi data mikrokontroler (Tugas Tertulis)</p> <p>Non-test: Task 4: <i>Regarding the features and peripherals of the microcontroller (Written Task)</i></p> <p>Task 5: <i>Designing microcontroller data communication and interface applications (Written Task)</i></p>	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas [TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • <i>Lecture, discussion, question and answer, exercise and assignment</i> [FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"] 	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom • <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i> 	<ul style="list-style-type: none"> • Pengenalan fitur dan peripheral mikrokontroler <ul style="list-style-type: none"> - Timer - Counter - Interrupt - PWM, I2C, SPI, USART, CAN - dan lain-lain • Metode perancangan antarmuka dan komunikasi data mikrokontroler, penggunaan input dan output dasar (push button, dipswitch, keypad, LED, LCD dan lain-lain), komunikasi serial, komunikasi wire dan wireless • Contoh-contoh rangkaian aplikasi antarmuka dan komunikasi data serta pemogramannya • <i>Introduction to the</i> 	<p>Tugas 4: 5</p> <p>Tugas 5: 5</p> <p>Task 4: 5</p> <p>Task 5: 5</p>

		<p><i>peripherals (timer, counter, interrupt, PWM, I2C, SPI, USART, CAN, etc.)</i></p> <ul style="list-style-type: none"> • <i>Able to perform microcontroller interface design and data communication methods, use of basic input and output (push button, dipswitch, keypad, LED, LCD and others), serial communication, wire and wireless communication.</i> • <i>Able to explain examples of a series of interface applications and data communication and programming</i> 				<p><i>features and peripherals of microcontroller</i></p> <ul style="list-style-type: none"> - <i>Timer</i> - <i>Counter</i> - <i>Interrupt</i> - <i>PWM, I2C, SPI, USART, CAN</i> - <i>and others</i> • <i>Microcontroller interface and data communication design methods, use of basic input and output (push button, dipswitch, keypad, LED, LCD, etc.), serial communication, wire and wireless communication</i> • <i>Examples of interface and data communication application series and their programming</i> 	
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						15
10 - 12	Mahasiswa mampu memahami dan menjelaskan	<ul style="list-style-type: none"> • Mampu memahami Pengenalan ADC dan 	Non-tes: Tugas 6:	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, 	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, 	<ul style="list-style-type: none"> • Pengenalan ADC dan DAC: 	

	<p>tentang analog to digital converter (ADC) dan digital to analog converter (DAC) serta penerapannya.</p> <p><i>Students are able to understand and explain about analog to digital converter (ADC) and digital to analog converter (DAC) and their applications.</i></p>	<p>DAC: konsep dasar (sample dan hold, proses sampling dan waktu konversi), jenis-jenis ADC dan DAC (ADC integrator, Dual Slope, Successive Approximation Ratio, Semi Flash dan Flash, R2R ladder DAC), rangkaian dasar ADC dan DAC dan antar muka dengan mikrokontroler</p> <ul style="list-style-type: none"> • Mampu memahami dan menjelaskan internal ADC dan DAC pada mikrokontroller dan penerapannya • Mampu menjelaskan contoh-contoh rangkaian aplikasi serta pemogramannya • <i>Able to understand Introduction to ADC and DAC: basic concepts (sample and hold, sampling process and conversion time), types of ADC and DAC</i> 	<p>Mengenai konsep dasar ADC dan DAC (Tugas Tertulis)</p> <p>Tugas 7: Perancangan aplikasi rangkaian ADC dan DAC serta antarmuka dengan mikrokontroler (Tugas Tertulis)</p> <p>Non-test: Task 6: <i>Regarding the basic concepts of ADC and DAC (Written Assignment)</i></p> <p>Task 7: <i>Designing ADC and DAC circuit applications and interfaces with a microcontroller (Written Task)</i></p>	<p>tugas</p> <p>[TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"]</p> <ul style="list-style-type: none"> • <i>Lecture, discussion, question and answer, exercise and assignment</i> <p>[FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]</p>	<p>tugas dalam platform myITS Classroom</p> <ul style="list-style-type: none"> • <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i> 	<ul style="list-style-type: none"> - Konsep dasar (sample dan hold, proses sampling dan waktu konversi) - Jenis-jenis adc dan dac (adc integrator, dual slope, successive approximation ratio, semi flash dan flash, r2r ladder dac) - Rangkaian dasar adc dan dac dan antar muka dengan mikrokontroler • Internal ADC dan DAC pada mikrokontroller dan penerapannya • Contoh-contoh rangkaian aplikasi serta pemogramannya • <i>Introduction to ADC</i> 	
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		<p><i>(ADC integrator, Dual Slope, Successive Approximation Ratio, Semi Flash and Flash, R2R ladder DAC), series basic ADC and DAC and interfaces with microcontrollers</i></p> <ul style="list-style-type: none"> • <i>Able to understand and explain the ADC and DAC internals on the microcontroller and its application</i> <i>Able to explain examples of a series of applications and its programming</i> 				<p><i>and DAC:</i></p> <ul style="list-style-type: none"> - <i>Basic concepts (sample and hold, sampling process and conversion time)</i> - <i>Types of adc and dac (adc integrator, dual slope, successive approximation ratio, semi flash and flash, r2r ladder dac)</i> - <i>Basic adc and dac circuit and interface with microcontroller</i> • <i>Internal ADC and DAC on the microcontroller and its application</i> • <i>Examples of application series and programming</i> 	
13 - 15	Mahasiswa mampu melakukan perancangan dan merealisasikan sistem	<ul style="list-style-type: none"> • Mampu mengaplikasikan metodologi 	Final Project: Penentuan tema final project	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas 	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, tugas dalam 	<ul style="list-style-type: none"> • Metodologi perancangan peralatan 	35

	<p>elektronika khususnya peralatan medis berbasis mikrokontroler dengan metode perancangan yang benar.</p> <p><i>Students are able to design and realize electronic systems, especially microcontroller-based medical devices with the correct design method.</i></p>	<p>perancangan peralatan elektronika berbasis mikrokontroler, spesifikasi, pemilihan komponen, perancangan sistem, verifikasi, integrasi sistem, test</p> <ul style="list-style-type: none"> • Mampu memahami pengenalan real time OS (RTOS) serta sistem elektronika tertanam berbasis mini computer (raspberry, cubie board, dll.) • <i>Able to apply microcontroller based electronic equipment design methodology, specifications, component selection, system design, verification, system integration, test</i> • <i>Able to understand the introduction of real time OS (RTOS) and embedded electronic systems based on mini</i> 	<p>diberikan pada minggu ke – 10. Proses evaluasi final project dilakukan pada minggu ke – 15 dan 16 (Tugas realisasi alat dan demo)</p> <p>Final Project: <i>Determination of the final project theme is given in week 10. The final project evaluation process is carried out on weeks 15 and 16 (Task realization of tools and demos)</i></p>	<p>[TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"]</p> <ul style="list-style-type: none"> • <i>Lecture, discussion, question and answer, exercise and assignment</i> <p>[FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]</p>	<p>platform myITS Classroom</p> <ul style="list-style-type: none"> • <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i> 	<p>elektronika berbasis mikrokontroler, spesifikasi, pemilihan komponen, perancangan sistem, verifikasi, integrasi sistem, test</p> <ul style="list-style-type: none"> • Pengenalan real time os (RTOS) serta sistem elektronika tertanam berbasis mini computer (raspberry, cubie board, dll.) • <i>Microcontroller-based electronic equipment design methodology, specifications, component selection, system design, verification, system integration, test</i> • <i>Introduction to real time OS (RTOS) and embedded</i> 	
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		<i>computers (raspberry, cubie board, etc.)</i>				<i>electronic systems based on mini computers (raspberry, cubie board, etc.)</i>	
16	EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM						15

TM=Tatap Muka, **PT**=Penugasan Terstruktur, **BM**=Belajar Mandiri.

II. Rencana Asesmen & Evaluasi (RAE) / *Assessment & Evaluation Plan*

	ASSESSMENT & EVALUATION PLAN		RA&E
	<p style="color: blue;">BACHELOR DEGREE PROGRAM OF BIOMEDICAL ENGINEERING - FTEIC ITS</p> <p style="color: blue;">Course : Fundamentals of Microcontrollers and Microprocessors</p>		<p>Write</p> <p>Doc Code</p>
Kode / Code: EB234401	Bobot sks / Credits (T/P): 3/0	Rumpun MK: Teknik Biomedik <i>Course Cluster: Biomedical Engineering</i>	Smt: 4
OTORISASI <i>AUTHORIZATION</i>	Penyusun RA & E <i>Compiler A&EP</i> Nada Fitriyatul H, S.T, M.T	Koordinator RMK <i>Course Cluster Coordinator</i> Dr. Rachmad Setiawan, S.T., M.T.	Ka DEP <i>Head of DEP</i> Dr. Achmad Arifin, S.T., M.Eng.

Mg ke / Week (1)	Sub CP-MK / <i>Lesson Learning Outcomes (LLO)</i> (2)	Bentuk Asesmen (Penilaian) <i>Form of Assessment</i> (3)	Bobot / <i>Load (%)</i> (4)
1-2	Sub CP-MK 1: Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikroprosesor dan perancangan perangkat keras mikroprosesor. LLO 1: <i>Students are able to understand and explain the basic</i>	Non-tes: Tugas 1: Mengenai konsep dasar dan perancangan perangkat keras mikroprosesor (Tugas Tertulis) Tes: ETS Soal 1 (masuk dalam penilaian ETS) Non-test: Task 1: <i>Regarding the basic concepts and design of microprocessor hardware (Written Task)</i> Test: <i>Mid-term examination question 1 (included in the mid-term assessment)</i>	8.75

Mg ke / Week (1)	Sub CP-MK / <i>Lesson Learning Outcomes (LLO)</i> (2)	Bentuk Asesmen (Penilaian) <i>Form of Assessment</i> (3)	Bobot / <i>Load (%)</i> (4)
	<i>concepts of microprocessors and microprocessor hardware design.</i>		
3	<p>Sub CP-MK 2:</p> <p>Mahasiswa mampu memahami dan menjelaskan tentang konsep dasar mikrokontroler dan tipe-tipe mikrokontroler.</p> <p>LLO 2:</p> <p><i>Students are able to understand and explain the basic concepts of microcontrollers and types of microcontrollers.</i></p>	<p>Non-tes:</p> <p>Tugas 2: Mengenai konsep dasar, struktur dan cara kerja dari mikrokontroler (Tugas Tertulis)</p> <p>Tes: ETS Soal 2 (masuk dalam penilaian ETS)</p> <p>Non-test:</p> <p>Task 2: <i>Regarding the basic concepts, structure and workings of a microcontroller (Written Task)</i></p> <p>Test: <i>Mid-term examination question 2 (included in the mid-term assessment)</i></p>	8.75
4 - 5	<p>Sub CP-MK 3:</p> <p>Mahasiswa mampu memahami dan menjelaskan tentang teknik pemrograman pada mikrokontroler.</p> <p>LLO 3:</p> <p><i>Students are able to understand and explain programming techniques on microcontrollers.</i></p>	<p>Non-tes:</p> <p>Tugas 3: Mengenai teknik pemrograman pada mikrokontroler (Tugas Tertulis)</p> <p>Tes: ETS Soal 3 (masuk dalam penilaian ETS)</p> <p>Non-test:</p> <p>Task 3: Regarding programming techniques on the microcontroller (Written Task)</p> <p>Test: <i>Mid-term examination question 3 (included in the mid-term assessment)</i></p>	8.75
6 - 9	<p>Sub CP-MK 4:</p> <p>Mahasiswa mampu memahami dan</p>	<p>Non-tes :</p> <p>Tugas 4: Mengenai fitur dan peripheral mikrokontroler (Tugas Tertulis)</p>	13.75

Mg ke / Week (1)	Sub CP-MK / <i>Lesson Learning Outcomes (LLO)</i> (2)	Bentuk Asesmen (Penilaian) <i>Form of Assessment</i> (3)	Bobot / <i>Load (%)</i> (4)
	<p>menjelaskan tentang fitur dan peripheral mikrokontroler, antarmuka dan komunikasi data pada mikrokontroler serta penerapannya.</p> <p>LLO 4:</p> <p><i>Students are able to understand and explain the features and peripherals of the microcontroller, the interface and data communication on the microcontroller and its applications.</i></p>	<p>Tugas 5: Perancangan aplikasi antarmuka dan komunikasi data mikrokontroler (Tugas Tertulis)</p> <p>Tes: ETS Soal 4 (masuk dalam penilaian ETS)</p> <p>Non-test: Task 4: <i>Regarding the features and peripherals of the microcontroller (Written Task)</i></p> <p>Task 5: <i>Designing microcontroller data communication and interface applications (Written Task)</i></p> <p>Test: <i>Mid-term examination question 4 (included in the mid-term assessment)</i></p>	
8	<p>Evaluasi Tengah Semester</p> <p>Mid-Semester Exam</p>	<p>Tes: Ujian Tulis/Ujian Daring</p> <p>Test: <i>Written Exams/Online Examinations</i></p>	
10 - 12	<p>Sub CP-MK 5:</p> <p>Mahasiswa memahami konsep sistem koordinat 3D dan penggunaannya dalam menurunkan motion equation.</p> <p>LLO 5:</p> <p><i>Students understand the concept of a 3D coordinate system</i></p>	<p>Non-tes: Tugas 6: Mengenai konsep dasar ADC dan DAC (Tugas Tertulis)</p> <p>Tugas 7: Perancangan aplikasi rangkaian ADC dan DAC serta antarmuka dengan mikrokontroler (Tugas Tertulis)</p> <p>Tes: EAS Soal 1 dan 2 (masuk dalam penilaian EAS)</p> <p>Non-test: Task 6: <i>Regarding the basic concepts of ADC and DAC (Written Assignment)</i></p> <p>Task 7: <i>Designing ADC and DAC circuit applications and interfaces</i></p>	20

Mg ke / Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	<i>and its use in deriving the motion equation.</i>	<i>with a microcontroller (Written Task)</i> Test: <i>Final examination questions 1 and 2 (included in the final assessment)</i>	
13 - 15	<p>Sub CP-MK 6:</p> <p>Mahasiswa mampu merealisasikan pemrograman 3D untuk aplikasi pemodelan sistem fisiologi tubuh manusia.</p> <p>LLO 6:</p> <p><i>Students are able to realize 3D programming for the application of modeling the human body physiology system.</i></p>	<p>Final Project: Penentuan tema final project diberikan pada minggu ke – 10. Proses evaluasi final project dilakukan pada minggu ke – 15 dan 16 (Tugas realisasi alat dan demo)</p> <p>Tes: EAS Soal 3 (masuk dalam penilaian EAS)</p> <p>Final Project: <i>Determination of the final project theme is given in week 10. The final project evaluation process is carried out on weeks 15 and 16 (Task realization of tools and demos)</i></p> <p>Test: <i>Final examination question 3 (included in the final assessment)</i></p>	40
16	<p>Evaluasi Akhir Semester</p> <p>Final Exam</p>	<p>Tes: Ujian Tulis/Ujian Daring</p> <p>Test: <i>Written Exams/Online Examinations</i></p>	
Total bobot penilaian Total assessment load			100%

Indikator Pencapaian CPL Pada MK / *Indicator of PLO achievement charged to the course*

CPL yang dibebankan pada MK / <i>PLO charged to the course</i>	CPMK / <i>Course Learning Outcome (CLO)</i>	Minggu ke / <i>Week</i>	Bentuk Asesmen / <i>Form of Assessment</i>	Bobot / <i>Load (%)</i>
CPL-03/ PLO-03	CPMK 6 / CLO 6	Week- 15	Final Project	35
		Week- 16	Final Exam Question 3	5
CPL-06 / PLO-06	CPMK 1 / CLO 1	Week- 1	Task 1	5
		Week- 8	Mid Exam Question 1	3.75
	CPMK 2 / CLO 2	Week- 3	Task 2	5
		Week- 8	Mid Exam Question 2	3.75
	CPMK 3 / CLO 3	Week- 4	Task 3	5
		Week- 8	Mid Exam Question 3	3.75
CPL-07 / PLO-07	CPMK 4 / CLO 4	Week- 6	Task 4 - 5	10
		Week- 8	Mid Exam Question 4	3.75
	CPMK 5 / CLO 5	Week- 10	Task 6 - 7	10
		Week- 16	Final Exam Question 1 - 2	10
				Σ = 100%

No	Form of Assessment	PLO-01	PLO-02	PLO-03	PLO-04	PLO-05	PLO-06	PLO-07	PLO-08	PLO-09	PLO-10	PLO-11	PLO-12	Total
1	Tugas 1						0.050							0.050
2	Tugas 2						0.050							0.050
3	Tugas 3						0.050							0.050
4	Tugas 4							0.050						0.050
5	Tugas 5							0.050						0.050
6	ETS						0.1125	0.0375						0.150
7	Tugas 6							0.050						0.050
8	Tugas 7							0.050						0.050
9	Final Project			0.350										0.350
10	EAS			0.050				0.100						0.150
	Total			0.400			0.2625	0.3375						1

