

Module Handbook

Rehabilitation Engineering



Bachelor Degree Program Department of Biomedical Engineering

Faculty of Intelligent Electrical Technology and Informatics
Institut Teknologi Sepuluh Nopember



MODULE HANDBOOK
Rehabilitation Engineering
DEPARTMENT OF BIOMEDICAL ENGINEERING
 INSTITUT TEKNOLOGI SEPULUH NOPEMBER
 Number : B/21385/IT2.IX.5.1.2/PP.03.00.00/2020

ENDORSEMENT PAGE

Proses <i>Process</i>	Penanggung Jawab <i>Person in Charge</i>			Tanggal <i>Date</i>
	Nama <i>Name</i>	Jabatan <i>Position</i>	Tandatangan <i>Signature</i>	
Perumus <i>Preparation</i>	Dr. Achmad Arifin, S.T., M.Eng.	Dosen <i>Lecturer</i>		November 18, 2022
Pemeriksa dan Pengendalian <i>Review and Control</i>	Fauzan Arrofiqi, S.T., M.T., Ph.D.	Tim kurikulum <i>Curriculum team</i>		November 20, 2022
Persetujuan <i>Approval</i>	Ir. Josaphat Pramudijanto, M.Eng.	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 REHABILITATION ENGINEERING

Module name	Rehabilitation Engineering	
Module level	Undergraduate	
Code	EB234906	
Course (if applicable)	Rehabilitation Engineering	
Semester	Specialization	
Person responsible for the module	Dr. Achmad Arifin, S.T., M.Eng.	
Lecturer	Dr. Achmad Arifin, S.T., M.Eng. Fauzan Arrofiqi, S.T., M.T., Ph.D.	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, Specialization	
Type of teaching, contact hours	Lectures, <60 students Tuesdays, 11.00-12.50 (GMT+7)	
Workload	1. Lectures : 3 x 50 = 150 minutes per week 2. Exercises and Assignments : 3 x 50 = 150 minutes per week 3. Private learning : 3 x 50 = 150 minutes 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	● Biomedical Instrumentation systems and Laboratory ● Biomedical Signal Processing and Laboratory	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module: CLO 1: Students are able to understand the history of rehabilitation engineering CLO 2: Students are able to understand and analyze the physiology of human muscles using biomechanical methods so that they can diagnose movement disorders, assess rehabilitation outcomes, and design rehabilitation technologies. CLO 3: Students are able to analyze and design one type of rehabilitation technique that is functional electrical stimulation CLO 4: Students are able to analyze and design one type of rehabilitation technique that is functional electrical stimulation	PLO-02 PLO-05 PLO-08 PLO-06

Content / Short Description of Course	The Rehabilitation Engineering course is a course that discusses basic concepts, types, how to work, and other things related to the restoration process of the human body. Rehabilitation engineering itself is an engineering method to return the human body to its original condition. This course aims to make students understand the concepts and methods of rehabilitation engineering available in medicine and their impact on the human body system.
Study and examination requirements and forms of examination	● In-class exercises ● Assignment 1, 2, 3, 4, 5, 6 ● Mid-term examination ● Final examination
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom
Reading list	Main : ● Cooper, Rory A., "An Introduction to Rehabilitation Engineering," CRC Press, 2007 ● Bronzino, Joseph D., "The Biomedical Engineering Handbook," CRC Press, 2000
	Supporting : ● Mark L Latash, "Neurophysiological basis of movement," Human Kinetics, USA, 1998 ● Robert M Enoka, "Neuromechanics of human movement," 3rd Ed., Human Kinetics, USA, 2002

I. Rencana Pembelajaran Semester / *Semester Learning Plan*

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF INTELLIGENT ELECTRICAL AND INFORMATICS TECHNOLOGY DEPARTMENT OF BIOMEDICAL ENGINEERING					Document Code
SEMESTER LEARNING PLAN						
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>
Teknik Rehabilitasi <i>Rehabilitation Engineering</i>	EB234906	Peminatan <i>Specialization</i>	T = 3	P = 0	Peminatan <i>Specialization</i>	Nov 19, 2022
OTORISASI / PENGESAHAN <i>AUTHORIZATION / ENDORSEMENT</i>	Dosen Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ka DEPARTEMEN <i>Head of Department</i>	
	(Dr. Achmad Arifin, S.T., M.Eng.)		(Ir. Josaphat Pramudijanto, M.Eng.)		(Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran Learning Outcomes	CPL-PRODI yang dibebankan pada MK PLO Program Charged to The Course					
	CPL-02 <i>PLO-02</i>	Mampu menerapkan ilmu pengetahuan, keterampilan, dan metode terkini dalam menyelesaikan permasalahan di bidang Teknik Biomedika <i>Able to apply the latest knowledge, skills and methods in solving problems in the field of Biomedical Engineering</i>				
	CPL-05 <i>PLO-05</i>	Mampu menemukan, memahami, menjelaskan, merumuskan, dan menyelesaikan permasalahan umum pada bidang Teknik dan permasalahan khusus pada bidang Teknik Biomedika yang meliputi instrumentasi biomedika cerdas, teknik rehabilitasi medika, pencitraan dan pengolahan citra medika, serta informatika medika <i>Able to find, understand, explain, formulate, and solve general problems in the field of Engineering and special problems in the field of Biomedical Engineering which includes intelligent biomedical instrumentation, medical rehabilitation techniques, imaging and processing of medical images, and medical informatics</i>				
	CPL-06	Mampu merancang dan melaksanakan eksperimen laboratorium dan/atau lapangan, menganalisa dan menginterpretasi data, serta menggunakan penilaian yang obyektif untuk menarik kesimpulan				

	PLO-06	Able to design and implement laboratory experiment and / or field experiments, analyze and interpret data, and use objective assessments to draw conclusions.
	CPL-08 PLO-08	Mampu mendesain komponen, sistem, dan proses dalam bidang Teknik Biomedika yang sistematis, logis, dan realistis sesuai dengan spesifikasi yang ditentukan dengan mempertimbangkan aspek keselamatan, sosial, budaya, lingkungan, dan ekonomi dengan mengenali/memanfaatkan sumber daya lokal dan nasional dengan wawasan global <i>Able to design components, systems, and processes in the field of Biomedical Engineering that are systematic, logical, and realistic appropriate with specified specifications by considering aspects of safety, social, cultural, environmental, and economic by recognizing/utilizing local and national resources with global insight</i>
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		
	CP MK 1 CLO 1	Mahasiswa mampu memahami sejarah adanya teknik rehabilitasi. <i>Students are able to understand the history of rehabilitation engineering.</i>
	CP MK 2 CLO 2	Mahasiswa mampu memahami dan menganalisa fisiologi dari otot manusia menggunakan metode biomekanik sehingga dapat mendiagnosa movement disorder, menilai hasil rehabilitasi, dan mendesain teknologi rehabilitasi. <i>Students are able to understand and analyze the physiology of human muscles using biomechanical methods so that they can diagnose movement disorders, assess rehabilitation outcomes, and design rehabilitation technologies.</i>
	CP MK 3 CLO 3	Mahasiswa mampu menganalisa dan mendesain salah satu jenis teknik rehabilitasi yaitu <i>functional electrical stimulation</i> . <i>Students are able to analyze and design one type of rehabilitation technique that is functional electrical stimulation</i>
	CP MK 4 CLO 4	Mahasiswa mampu menganalisa dan mendesain teknik rehabilitasi berbasis Functional Electrical Stimulation, Robotik, dan Hybrid <i>Students are able to analyze and design rehabilitation techniques based on Functional Electrical Stimulation, Robotic and Hybrid</i>

Peta CPL – CP MK <i>Map of PLO - CLO</i>	<table><tr><th></th><th>CPL-01</th><th>CPL-02</th><th>CPL-03</th><th>CPL-04</th><th>CPL-05</th><th>CPL-06</th><th>CPL-07</th><th>CPL-08</th><th>CPL-09</th><th>CPL-10</th><th>CPL-11</th><th>CPL-12</th></tr><tr><td>CPMK 1 / SUB CPMK 1 <i>CLO 1 / LLO 1</i></td><td></td><td>✓</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CPMK 2 / SUB CPMK 2 <i>CLO 2 / LLO 2</i></td><td></td><td></td><td></td><td></td><td>✓</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CPMK 3 / SUB CPMK 3 <i>CLO 3 / LLO 3</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>✓</td><td></td><td></td><td></td><td></td></tr><tr><td>CPMK 4 / SUB CPMK 4 <i>CLO 4 / LLO 4</i></td><td></td><td></td><td></td><td></td><td></td><td>✓</td><td></td><td>✓</td><td></td><td></td><td></td><td></td></tr></table>		CPL-01	CPL-02	CPL-03	CPL-04	CPL-05	CPL-06	CPL-07	CPL-08	CPL-09	CPL-10	CPL-11	CPL-12	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>						✓		✓				
	CPL-01	CPL-02	CPL-03	CPL-04	CPL-05	CPL-06	CPL-07	CPL-08	CPL-09	CPL-10	CPL-11	CPL-12																																																						
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>						✓		✓																																																										
Diskripsi Singkat MK <i>Short Description of Course</i>	Mata kuliah Teknik Rehabilitasi merupakan mata kuliah yang membahas tentang konsep dasar, jenis, cara kerja, dan hal-hal lain yang berhubungan dengan proses restorasi tubuh manusia. Teknik rehabilitasi sendiri merupakan suatu metode rekayasa / engineering untuk mengembalikan kondisi tubuh manusia kepada kondisi semula. Mata kuliah ini bertujuan agar mahasiswa memahami konsep dan metode teknik rehabilitasi yang telah tersedia di dunia kedokteran dan dampaknya pada sistem tubuh manusia. <i>The Rehabilitation Engineering course is a course that discusses basic concepts, types, how to work, and other things related to the restoration process of the human body. Rehabilitation engineering itself is an engineering method to return the human body to its original condition. This course aims to make students understand the concepts and methods of rehabilitation engineering available in medicine and their impact on the human body system.</i>																																																																	
Bahan Kajian / Materi Pembelajaran <i>Course Materials</i>	1. Sejarah teknik rehabilitasi / <i>Rehabilitation engineering history</i> 2. Pengukuran dan analisa gerak tubuh / <i>Measurement and analysis of body movements</i> 3. Fisiologi otot / <i>Muscle physiology : muscle strength, muscle power, adaptation to reduced use, motor recovery after nervous system injury, adaptation with age</i> 4. <i>Functional Electrical Stimulation : fatigue, aging, rehabilitasi motorik</i> 5. <i>Robotic Rehabilitation</i> 6. <i>Hybrid System</i> 7. Efek obat-obatan pada rehabilitasi serta advocacy / <i>the effects of drugs on rehabilitation and advocacy</i>																																																																	

Pustaka	Utama / Main:
References	• Cooper, Rory A., "An Introduction to Rehabilitation Engineering," CRC Press, 2007 • Bronzino, Joseph D., "The Biomedical Engineering Handbook," CRC Press, 2000
	Pendukung / Supporting:
	• Mark L Latash, "Neurophysiological basis of movement," Human Kinetics, USA, 1998 • Robert M Enoka, "Neuromechanics of human movement," 3rd Ed., Human Kinetics, USA, 2002
Dosen Pengampu Lecturers	Dr. Achmad Arifin, S.T., M.Eng. Fauzan Arrofiqi, S.T., M.T., Ph.D.
Matakuliah syarat Prerequisite	• EB234406 Sistem Instrumentasi Biomedika dan Laboratorium • EB234404 Pengolahan Sinyal Biomedika dan Laboratorium • <i>EB234406 Biomedical Instrumentation systems and Laboratory</i> • <i>EB234404 Biomedical Signal Processing and Laboratory</i>

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assessment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	
(1)	(2)	(3)	(4)			(7)	(8)
1-4	Mahasiswa mampu memahami sejarah adanya teknik rehabilitasi <i>Students are able to understand the history of rehabilitation engineering</i>	• Kelengkapan dan kerapian hasil resume • Ketepatan waktu pengumpulan tugas • Kebenaran melaksanakan tugas • Keberhasilan menjelaskan tugas dengan baik • <i>Completeness and neatness of the resume results</i> • <i>On time submission of assignments</i> • <i>Tasks performed correctly</i> • <i>Success in completing assignments well</i>	Non-Tes : Tugas 1: Resume mengenai sejarah teknik rehabilitasi dan jenis-jenis teknik rehabilitasi Non-Test : Task 1: <i>Resume on the history of rehabilitation engineering and types of rehabilitation engineering</i>	• Kuliah dan brainstorming, tanya jawab [<i>TM : 1 x 3 x 50"</i>] [<i>BM : 1 x 3 x 50"</i>] [<i>PT : 1 x 3 x 50"</i>] • <i>Presentation and brainstorming, ask and answer</i> [<i>FF : 1 x 3 x 50"</i>] [<i>SA : 1 x 3 x 50"</i>] [<i>SS : 1 x 3 x 50"</i>]	• Chatting dan diskusi dalam forum platform ITS • <i>Chat and discussion in ITS platform forum</i>	• Kontrak kuliah: - Motivasi belajar - Rencana pembelajaran - Aturan-aturan perkuliahan - Tujuan perkuliahan - Sistem penilaian, buku ajar/sumber pustaka • Definisi rehabilitasi • Teknik rehabilitasi • Sejarah teknik rehabilitasi • Konsep teknik rehabilitasi	5

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assess- ment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
(1)	(2)	(3)	(4)			[Link materi di MyITSClassroom] • <i>Course contract:</i> - <i>Motivation to learn</i> - <i>Lesson plan</i> - <i>Lecture rules</i> - <i>Course objective</i> - <i>Assessment system,</i> - <i>textbooks / library resources</i> • <i>Definition of rehabilitation</i> • <i>Rehabilitation Engineering</i> • <i>History of rehabilitation engineering</i>	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assessment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class (5)</i>	Daring / <i>Online (6)</i>	(7)	(8)
(1)	(2)	(3)	(4)			<i>The concept of rehabilitation engineering</i> [<i>Course materials link at MyITSClassroom</i>]	
5-7	Mahasiswa mampu menjelaskan dan menganalisa aspek-aspek sistem gerak manusia antara yang sehat dan cacat dan mendiskusikan penggunaannya dalam merancang teknik rehabilitasi <i>Students are able to explain and analyze aspects of the human movement system between healthy and disabled and discuss their use in designing rehabilitation techniques</i>	- Kebenaran pemahaman, jawaban dan analisa - Keberhasilan menjelaskan tugas - Ketepatan waktu pengumpulan tugas <i>Correct in understanding, answers and analysis</i> <i>Able to explain the assignments</i>	Non-Tes : Tugas 2: Mengerjakan soal-soal yang berhubungan dengan sistem, pengukuran, dan analisa gerak manusia Non-Test : Task 2: Solving the problems related to systems, measurements, and analysis of human motion	- Kuliah, diskusi, tanya jawab, latihan soal, tugas [<i>TM: 3 x 3 x 50"</i>] [<i>BM: 3 x 3 x 50"</i>] [<i>PT: 3 x 3 x 50"</i>] <i>Presentation, discussion, ask and answer, exercise, assignment</i> [<i>FF: 3 x 3 x 50"</i>] [<i>SA: 3 x 3 x 60"</i>] [<i>SS: 3 x 3 x 60"</i>]		- Sistem gerak manusia - Pengukuran gerak manusia - Analisa gerak manusia [<i>Link materi di MyITSClassroom</i>] <i>Human motion system</i> <i>Measurement of human motion</i>	10

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assessment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
(1)	(2)	(3)	(4)				
		On time submission of assignments				Human motion analysis [Course materials link at MyITSClassroom]	
5-7	Mahasiswa mampu memahami dan menganalisa fisiologi dari otot manusia menggunakan metode biomekanik sehingga dapat mendiagnosa movement disorder, menilai hasil rehabilitasi, dan mendesain teknologi rehabilitasi <i>Students are able to understand and analyze the physiology of human muscles using biomechanical methods so that they can diagnose movement disorders, assess rehabilitation outcomes, and design rehabilitation technologies</i>	- Kebenaran pemahaman, jawaban dan analisa - Keberhasilan menjelaskan tugas - Ketepatan waktu pengumpulan tugas - Correct in understanding, answers and analysis - Able to explain the assignments	Non-Tes : Tugas 3: Mengerjakan soal yang berhubungan dengan: - Contoh konsep pada fisiologi otot manusia - Pengaruh intensitas penggunaan otot terhadap kekuatan otot Non-Test : Task 3:	- Kuliah, diskusi, tanya jawab, latihan soal, tugas [TM: 3 x 3 x 50"] [BM: 3 x 3 x 50"] [PT: 3 x 3 x 50"] - Presentation, discussion, ask and answer, exercise, assignment [FF: 3 x 3 x 50"] [SA: 3 x 3 x 50"] [SS: 3 x 3 x 50"]		- Dasar fisiologi otot manusia - Muscle strength - Muscle power - Adaptation to reduced use - Motor recovery after nervous system injury - Adaptation with age [Link materi di MyITSClassroom]	15

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assessment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
		On time submission of assignments	Work on problems related to: - Examples of concepts on human muscle physiology - Effect of intensity of use of muscles on muscle strength			- Basic physiology of human muscles - Muscle strength - Muscle power - Adaptation to reduced use - Motor recovery after nervous system injury - Adaptation with age [Course materials link at MyITSClassroom]	
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						20
9 - 12	Mahasiswa mampu menganalisa dan mendesain teknik rehabilitasi berbasis Functional Electrical	- Kebenaran pemahaman, jawaban dan analisa - Keberhasilan menjelaskan tugas	Non-Tes : Tugas 4: Mengerjakan soal tentang aplikasi statika pada	Kuliah, diskusi, tanya jawab, latihan soal, tugas [TM: 4 x 3 x 50"] [BM: 4 x 3 x 50"]		Definisi functional electrical stimulation, robotic	20

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)	(7)	(8)
(1)	(2)	(3)	(4)			(7)	(8)
	Stimulation, Robotik, dan Hybrid <i>Students are able to analyze and design rehabilitation techniques based on Functional Electrical Stimulation, Robotic and Hybrid</i>	• Ketepatan waktu pengumpulan tugas • Correct in understanding, answers and analysis • Able to explain the assignments • On time submission of assignments	persendian tubuh manusia Tugas 5: Merancang hardware dan software untuk sistem FES Non-Test : Task 4: <i>Solving the problems about the application of statics to the joints of the human body</i> Task 5: <i>Design hardware and software for FES system</i>	[PT : 4 x 3 x 50"] • Presentation, discussion, ask and answer, exercise, assignment [FF : 4 x 3 x 50"] [SA : 4 x 3 x 50"] [SS : 4 x 3 x 50"]		rehabilitation, hybrid system • Desain functional electrical stimulation, robotic rehabilitation, hybrid system • Rehabilitasi motorik • Fatigue • Aging [Link materi di MyITSClassroom] • Definition of functional electrical stimulation, robotic rehabilitation, hybrid system	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assessment Load</i> (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	
(1)	(2)	(3)	(4)				(8)
						• <i>Desain functional electrical stimulation, robotic rehabilitation, hybrid system</i> • <i>Rehabilitasi motorik</i> • <i>Fatigue</i> • <i>Aging</i> [<i>Course materials link at MyITSClassroom</i>]	
13 -14	Mahasiswa memahami dan menganalisa efek obat-obatan pada rehabilitasi serta advocacy dari penggunaan obat-obatan tersebut <i>Students understand and analyze the effects of drugs on</i>	• Kelengkapan dan kerapian hasil resume • Ketepatan waktu pengumpulan tugas • Kebenaran melaksanakan tugas	Non Tes: Tugas 6: • Resume tentang advocacy pada penggunaan obat-obatan untuk rehabilitasi • Presentasi tentang	• Kuliah, diskusi, tanya jawab, latihan soal, tugas [<i>TM: 2 x 3 x 50"</i>] [<i>BM: 2 x 3 x 50"</i>] [<i>PT : 2 x 3 x 50"</i>]		• Obat-obatan pada rehabilitasi • Advokasi dari penggunaan obat-obatan untuk rehabilitasi	10

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bantuan Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)	(7)	
(1)	(2)	(3)	(4)			(7)	(8)
	rehabilitation and advocacy of the use of these drugs	- Keberhasilan menjelaskan tugas dengan baik - Kebenaran isi presentasi - Kelancaran dan keberhasilan menyampaikan materi - Laporan tertulis - Completeness and neatness of the resume results - Timeliness of submitting assignments - Truth does the job - Success in defining assignments well - Correctness of presentation content	obat-obatan pada jenis rehabilitasi tertentu Non-Test: Task 6: - Resumes about advocacy on the use of drugs for rehabilitation - Presentations about drugs in certain types of rehabilitation	Presentation, discussion, ask and answer, exercise, assignment [FF : 2 x 3 x 50"] [SA : 2 x 3 x 50"] [SS : 2 x 3 x 50"]		[Link materi di MyITSClassroom] - Medicines on rehabilitation - Advocacy of the use of drugs for rehabilitation [Course materials link at MyITSClassroom]	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assess- ment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
(1)	(2)	(3)	(4)				
		• <i>Smoothness and success in delivering material</i> • <i>Written report</i>					
15-16	EVALUASI AKHIR SEMESTER <i>FINAL-SEMESTER EXAM</i>						20

TM = Tatap Muka, **PT** = Penugasan Terstruktur, **BM** = Belajar Mandiri.
FF = Face to Face, **SA** = Structured Assignment, **SS** = Self Study.

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

	ASSESSMENT & EVALUATION PLAN BACHELOR DEGREE PROGRAM OF BIOMEDICAL ENGINEERING - FTEIC ITS Course : Rehabilitation Engineering		RA&E
			Write Doc Code
Kode/code: EB234906	Bobot sks/credits (T/P): 3/0	Rumpun MK: Biocybernetics Course Cluster: Biocybernetics	Peminatan Specialization
OTORISASI AUTHORIZATION	Penyusun RA & E Compiler A&EP Fauzan Arrofiqi, S.T., M.T., Ph.D.	Koordinator RMK Course Cluster Coordinator Ir. Josaphat Pramudijanto, M.Eng.	Ka DEPARTEMEN Head of Department Dr. Norma Hermawan, S.T., M.Sc.

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
1-4	Sub CP-MK 1: Mahasiswa mampu memahami sejarah adanya teknik rehabilitasi LLO 1: <i>Students are able to understand the history of rehabilitation engineering</i>	Tes: ETS Soal 1 dan 2 (10% dari ETS 15%) Presentasi Final Proyek Test: Question 1 and 2 in Mid Exam (10% of Mid Exam 15%) Final Project Presentation	20
5-7	Sub CP-MK 2: Mahasiswa mampu menjelaskan dan menganalisa aspek-aspek sistem gerak manusia antara yang sehat dan cacat dan mendiskusikan penggunaannya dalam merancang teknik rehabilitasi LLO 2: <i>Students are able to explain and analyze aspects of the human movement system between healthy and disabled and discuss their use in designing</i>	Non-Tes : Tugas Tertulis 1: Resume mengenai sejarah teknik rehabilitasi dan jenis-jenis teknik rehabilitasi Tugas Tertulis 2: Mengerjakan soal-soal yang berhubungan dengan sistem, pengukuran, dan analisa gerak manusia Tes: ETS Soal 3 (5% dari ETS 15%) Presentasi Proyek Akhir Non-Test : Written Assignment 1: Resume on the history of rehabilitation engineering and types of rehabilitation engineering Written Assignment 2:	20

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	rehabilitation techniques	Solving the problems related to systems, measurements, and analysis of human motion Test: Question 3 in Mid Exam (5% of Mid Exam 15%) Final project presentation.	
8	Evaluasi Tengah Semester Mid Exam	Tes: Ujian Tulis/Ujian Daring Test: Written Exams / Online Exams	20
9-12	Sub CP-MK 3: Mahasiswa mampu menganalisa dan mendesain salah satu jenis teknik rehabilitasi yaitu <i>functional electrical stimulation</i> . LLO 3: <i>Students are able to analyze and design one type of rehabilitation technique that is functional electrical stimulation.</i>	Non-Tes : Tugas Tertulis 3: - Mengerjakan soal yang berhubungan dengan contoh konsep pada fisiologi otot manusia - Mengerjakan soal yang berhubungan dengan pengaruh intensitas penggunaan otot terhadap kekuatan otot Tugas Proyek 1: Merancang hardware dan software untuk sistem FES Non-Test : Written Assignment 3: - Solving the problems related to examples of concepts on human muscle physiology - Solving the problems related to effect of intensity of use of muscles on muscle strength Project Assignment 1: Design hardware and software for FES system	10
13-14	Sub CP-MK 4: Mahasiswa mampu menganalisa dan mendesain teknik rehabilitasi berbasis Functional Electrical Stimulation, Robotik, dan Hybrid LLO 4: <i>Students are able to analyze and design rehabilitation techniques based on</i>	Non-Tes : Tugas Tertulis 4: Mengerjakan soal tentang aplikasi statika pada persendian tubuh manusia Tugas Tertulis 5: - Resume tentang advocacy pada penggunaan obat-obatan untuk rehabilitasi - Presentasi tentang obat-obatan pada jenis rehabilitasi tertentu Tugas Proyek 1: Merancang hardware dan software untuk sistem FES Tes:	50

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	<i>Functional Electrical Stimulation, Robotic and Hybrid</i>	Presentasi Proyek Akhir Non-test : Written Assignment 4: <i>Solving the problems about the application of statics to the joints of the human body</i> Written Assignment 5: - Resumes about advocacy on the use of drugs for rehabilitation - Presentations about drugs in certain types of rehabilitation Project Assignment 1: <i>Design hardware and software for FES system</i> Test: <i>Final Project Presentation</i>	
15-16	Proyek Akhir Final Project	Tes: Presentasi proyek akhir. Test: <i>Final project presentation.</i>	
Total bobot penilaian Total assessment load			100%

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

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-02 / PLO-02	CPMK 1 / CLO 1	Week- 8	Mid Exam Question 1 & 2	10
		Week- 15-16	Final Project Presentation	10
CPL-05 / PLO-05	CPMK 2 / CLO 2	Week- 5-7	Written Assignment 1 & 2	10
		Week- 8	Mid Exam Question 3	5
		Week- 15-16	Final Project Presentation	5
CPL-06 / PLO-06	CPMK 4 / CLO 4	Week 13-14	Written Assignment 4 & 5	10
		Week 13-14	Project Assignment 1	15
		Week- 15-16	Final Project Presentation	15
CPL-08 / PLO-08	CPMK 3 / CLO 3	Week- 9-12	Written Assignment 3	5
		Week- 9-12	Project Assignment 1	5
	CPMK 4 / CLO 4	Week 13-14	Written Assignment 4 & 5	5
		Week 13-14	Project Assignment 1	5
		Week 15-16	Final Project Presentation	10
				$\Sigma = 100\%$

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 (5 Tugas Tertulis) <i>Task 1 (5 Written Assignment)</i>					0.1	0.06		0.09					0.25
2	Evaluasi Tengah Semester		0.1			0.05								0.15

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
	Mid Term Exam													
3	Tugas 2 (1 Tugas Proyek) Task 2 (1 Project Assignment)						0.09		0.11					0.2
4	Proyek Akhir Final Project		0.1			0.05	0.15		0.1					0.4
	Total		0.2			0.2	0.3		0.3					1



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