



# MODULE HANDBOOK REHABILITATION ENGINEERING



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

**INSTITUT TEKNOLOGI SEPULUH NOPEMBER**



## ENDORSEMENT PAGE



# MODULE HANDBOOK Rehabilitation Engineering

## DEPARTMENT OF BIOMEDICAL ENGINEERING

INSTITUT TEKNOLOGI SEPULUH NOPEMBER  
Number : 6886/IT2.IX.5.1.2/B/PP.03.00.00/2023

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>	Ir. Josaphat Pramudijanto, M.Eng.	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

# MODULE HANDBOOK


## REHABILITATION ENGINEERING

Module name	<b>Rehabilitation Engineering</b>	
Module level	Undergraduate	
Code	EB234906	
Course (if applicable)	Rehabilitation Engineering	
Semester	Specialization	
Person responsible for the module	Fauzan Arrofiqi, S.T., M.T., Ph.D.	
Lecturer	<ol style="list-style-type: none"> <li>1. Prof. Dr. Ir. Mohammad Nuh, DEA.</li> <li>2. Ir. Siti Halimah Baki, M.T.</li> <li>3. Dr. Achmad Arifin, S.T., M.Eng.</li> <li>4. M. Hilman Fatoni, S.T., M.T.</li> </ol>	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, <b>Specialization</b>	
Type of teaching, contact hours	Lectures, <60 students Tuesdays, 11.00-12.50 (GMT+7)	
Workload	<ol style="list-style-type: none"> <li>1. Lectures : 3 x 50 = 150 minutes per week</li> <li>2. Exercises and Assignments : 3 x 50 = 150 minutes per week</li> <li>3. Private learning : 3 x 50 = 150 minutes per week</li> </ol>	
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	<ul style="list-style-type: none"> <li>• Biomedical Instrumentation systems and Laboratory</li> <li>• Biomedical Signal Processing and Laboratory</li> </ul>	
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 explain and analyze aspects of the human movement system between healthy and	PLO-02

	<p>disabled and discuss their use in designing rehabilitation engineering</p> <p>CLO 3: 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</p> <p>CLO 4: Students are able to analyze and design one type of rehabilitation technique that is functional electrical stimulation</p> <p>CLO 5: Students understand and analyze the effects of drugs on rehabilitation and advocacy of the use of these drugs</p>	<p>PLO-02</p> <p>PLO-06</p> <p>PLO-05</p> <p>PLO-08</p>
Content / Short Description of Course	<p>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.</p>	
Study and examination requirements and forms of examination	<ul style="list-style-type: none"> <li>• In-class exercises</li> <li>• Assignment 1, 2, 3, 4, 5, 6</li> <li>• Mid-term examination</li> <li>• Final examination</li> </ul>	
Media employed	<p>LCD, whiteboard, websites (myITS Classroom), zoom</p>	
Reading list	<p>Main :</p> <ul style="list-style-type: none"> <li>• Cooper, Rory A., "An Introduction to Rehabilitation Engineering," CRC Press, 2007</li> <li>• Bronzino, Joseph D., "The Biomedical Engineering Handbook," CRC Press, 2000</li> </ul>	

	<p>Supporting :</p> <ul style="list-style-type: none"><li>• Mark L Latash, "Neurophysiological basis of movement," Human Kinetics, USA, 1998</li><li>• Robert M Enoka, "Neuromechanics of human movement," 3<sup>d</sup> Ed., Human Kinetics, USA, 2002</li></ul>
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**I. Rencana Pembelajaran Semester / Semester Learning Plan**

	<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FACULTY OF INTELLIGENT ELECTRICAL AND INFORMATICS TECHNOLOGY</b> <b>DEPARTMENT OF BIOMEDICAL ENGINEERING</b>					<b>Document Code</b>
	<b>SEMESTER LEARNING PLAN</b>					
<b>MATA KULIAH (MK)</b> <i>COURSE</i>	<b>KODE</b> <i>CODE</i>	<b>Rumpun MK</b> <i>Course Cluster</i>	<b>BOBOT (sks)</b> <i>Credits</i>		<b>SEMESTER</b>	<b>Tgl Penyusunan</b> <i>Compilation Date</i>
<b>Teknik Rehabilitasi</b> <i>Rehabilitation Engineering</i>	<b>EB234906</b>	<b>Peminatan</b> <i>Specialization</i>	<b>T = 3</b>	<b>P = 0</b>	<b>Peminatan</b> <i>Specialization</i>	<b>Nov 19, 2022</b>
<b>OTORISASI / PENGESAHAN</b> <i>AUTHORIZATION / ENDORSEMENT</i>	<b>Dosen Pengembang RPS</b> <i>Developer Lecturer of Semester Learning Plan</i>		<b>Koordinator RMK</b> <i>Course Cluster Coordinator</i>		<b>Ka DEPARTEMEN</b> <i>Head of Department</i>	
	<b>(Fauzan Arrofiqi, S.T., M.T., Ph.D.)</b>		<b>(Dr. Norma Hermawan, S.T., M.T., M.Sc.)</b>		<b>(Dr. Achmad Arifin, S.T., M.Eng.)</b>	
<b>Capaian Pembelajaran</b>	<b>CPL-PRODI yang dibebankan pada MK</b> <i>PLO Program Charged to The Course</i>					

<b>Learning Outcomes</b>	CPL-02  PLO-02	Mampu <b>menemukan, memahami, menjelaskan, merumuskan, dan menyelesaikan</b> 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 <b>find, understand, explain, formulate, and solve</b> 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-05  PLO-05	Mampu <b>mendesain</b> 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 <b>mengenali/memanfaatkan</b> sumber daya lokal dan nasional dengan wawasan global  <i>Able to <b>design</b> 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 <b>recognizing/utilizing</b> local and national resources with global insight</i>
	CPL-06  PLO-06	Mampu <b>menerapkan</b> ilmu pengetahuan, keterampilan, dan metode terkini dalam menyelesaikan permasalahan di bidang Teknik Biomedika  <i>Able to <b>apply</b> the latest knowledge, skills and methods in solving problems in the field of Biomedical Engineering</i>
	CPL-08  PLO-08	Mampu <b>bekerja</b> dalam tim lintas disiplin dan budaya serta <b>bertanggung jawab</b> kepada masyarakat dan <b>mematuhi hukum dan etika profesi</b> dalam menyelesaikan masalah Teknik Biomedika  <i>Able to <b>work</b> in interdisciplinary and intercultural teams and be <b>responsible</b> to the community and <b>comply with legal and professional ethics</b> in solving Biomedical Engineering problems</i>
	<b>Capaian Pembelajaran Mata Kuliah (CPMK) – Bila CP MK sebagai kemampuan pada tiap tahap pembelajaran CP MK = Sub CP MK</b>	

<b>Course Learning Outcome (CLO) - If CLO as description capability of each Learning Stage in the course, then CLO = LLO</b>	
<b>CP MK 1</b> <b>CLO 1</b>	Mahasiswa mampu memahami sejarah adanya teknik rehabilitasi <i>Students are able to understand the history of rehabilitation engineering</i>
<b>CP MK 2</b> <b>CLO 2</b>	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 engineering</i>
<b>CP MK 3</b> <b>CLO 3</b>	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>
<b>CP MK 4</b> <b>CLO 4</b>	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>
<b>CP MK 5</b> <b>CLO 5</b>	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 rehabilitation and advocacy of the use of these drugs</i>



Peta CPL – CP MK												
Map of PLO - CLO												
	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 CLO 1 / LLO 1		√										
CPMK 2 / SUB CPMK 2 CLO 2 / LLO 2		√										
CPMK 3 / SUB CPMK 3 CLO 3 / LLO 3						√						
CPMK 4 / SUB CPMK 4 CLO 4 / LLO 4					√							
CPMK 5 / SUB CPMK 5 CLO 5 / LLO 5								√				
<b>Diskripsi Singkat MK</b>  <i>Short Description of Course</i>	<p>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.</p> <p><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></p>											

<p><b>Bahan Kajian / Materi Pembelajaran</b></p> <p><i>Course Materials</i></p>	<ol style="list-style-type: none"> <li>1. Sejarah teknik rehabilitasi / <i>Rehabilitation engineering history</i></li> <li>2. Pengukuran dan analisa gerak tubuh / <i>Measurement and analysis of body movements</i></li> <li>3. Fisiologi otot / <i>Muscle physiology : muscle strength, muscle power, adaptation to reduced use, motor recovery after nervous system injury, adaptation with age</i></li> <li>4. <i>Functional Electrical Stimulation : fatigue, aging, rehabilitasi motorik</i></li> <li>5. <i>Robotic Rehabilitation</i></li> <li>6. <i>Hybrid System</i></li> <li>7. Efek obat-obatan pada rehabilitasi serta advocacy / <i>the effects of drugs on rehabilitation and advocacy</i></li> </ol>
<p><b>Pustaka</b></p> <p><i>References</i></p>	<p><b>Utama / Main:</b></p> <ul style="list-style-type: none"> <li>• Cooper, Rory A., "An Introduction to Rehabilitation Engineering," CRC Press, 2007</li> <li>• Bronzino, Joseph D., "The Biomedical Engineering Handbook," CRC Press, 2000</li> </ul> <p><b>Pendukung / Supporting:</b></p> <ul style="list-style-type: none"> <li>• Mark L Latash, "Neurophysiological basis of movement," Human Kinetics, USA, 1998</li> <li>• Robert M Enoka, "Neuromechanics of human movement," 3rd Ed., Human Kinetics, USA, 2002</li> </ul>
<p><b>Dosen Pengampu</b></p> <p><i>Lecturers</i></p>	<ol style="list-style-type: none"> <li>1. Prof. Dr. Ir. Mohammad Nuh, DEA.</li> <li>2. Ir. Siti Halimah Baki, M.T.</li> <li>3. Dr. Achmad Arifin, S.T., M.Eng.</li> <li>4. M. Hilman Fatoni, S.T., M.T.</li> </ol>

<b>Matakuliah syarat</b>  <b>Prerequisite</b>	<ul style="list-style-type: none"> <li>• Sistem Instrumentasi Biomedika dan Laboratorium</li> <li>• Pengolahan Sinyal Biomedika dan Laboratorium</li>   <li>• <i>Biomedical Instrumentation systems and Laboratory</i></li> <li>• <i>Biomedical Signal Processing and Laboratory</i></li> </ul>
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Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bantuk 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 / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	<p>Mahasiswa mampu memahami sejarah adanya teknik rehabilitasi</p> <p><i>Students are able to understand the history of rehabilitation engineering</i></p>	<ul style="list-style-type: none"> <li>• Kelengkapan dan kerapian hasil resume</li> <li>• Ketepatan waktu pengumpulan tugas</li> <li>• Kebenaran melaksanakan tugas</li> <li>• Keberhasilan menjelaskan tugas dengan baik</li> <li>• <i>Completeness and neatness of the resume results</i></li> </ul>	<p><b>Non-Tes :</b></p> <p><b>Tugas 1:</b> Resume mengenai sejarah teknik rehabilitasi dan jenis-jenis teknik rehabilitasi</p> <p><b>Non-Test :</b> <b>Task 1:</b> <i>Resume on the history of rehabilitation engineering and types of rehabilitation engineering</i></p>	<ul style="list-style-type: none"> <li>• 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></li> <li>• <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></li> </ul>	<ul style="list-style-type: none"> <li>• Chatting dan diskusi dalam forum platform ITS</li> <li>• <i>Chat and discussion in ITS platform forum</i></li> </ul>	<ul style="list-style-type: none"> <li>• Kontrak kuliah: <ul style="list-style-type: none"> <li>- Motivasi belajar</li> <li>- Rencana pembelajaran</li> <li>- Aturan-aturan perkuliahan</li> <li>- Tujuan perkuliahan</li> <li>- Sistem penilaian, buku ajar/sumber pustaka</li> </ul> </li> <li>• Definisi rehabilitasi</li> </ul>	5

Mg ke/ Week	Kemampuan akhir tiap tahap 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 &amp; Techniques</i>	Tatap Muka / <i>In-class (5)</i>	Daring / <i>Online (6)</i>	(7)	(8)
(1)	(2)	(3)	(4)				
		<ul style="list-style-type: none"> <li>• <i>On time submission of assignments</i></li> <li>• <i>Tasks performed correctly</i></li> <li>• <i>Success in completing assignments well</i></li> </ul>				<ul style="list-style-type: none"> <li>• Teknik rehabilitasi</li> <li>• Sejarah teknik rehabilitasi</li> <li>• Konsep teknik rehabilitasi</li> </ul> <p>[<a href="#">Link materi di MyITSClassroom</a>]</p> <ul style="list-style-type: none"> <li>• <i>Course contract:</i> <ul style="list-style-type: none"> <li>- <i>Motivation to learn</i></li> <li>- <i>Lesson plan</i></li> <li>- <i>Lecture rules</i></li> <li>- <i>Course objective</i></li> <li>- <i>Assessment system, textbooks / library resources</i></li> </ul> </li> <li>• <i>Definition of rehabilitation</i></li> <li>• <i>Rehabilitation Engineering</i></li> </ul>	

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</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 / Assessment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria &amp; Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
(1)	(2)	(3)	(4)				
						<ul style="list-style-type: none"> <li>History of rehabilitation engineering</li> <li>The concept of rehabilitation engineering</li> </ul> <p>[<i>Course materials link at MyITSClassroom</i>]</p>	
2-4	<p>Mahasiswa mampu menjelaskan dan menganalisa aspek-aspek sistem gerak manusia antara yang sehat dan cacat dan mendiskusikan penggunaannya dalam merancang teknik rehabilitasi</p> <p><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></p>	<ul style="list-style-type: none"> <li>Keberhasilan menjawab dan analisa</li> <li>Keberhasilan menjelaskan tugas</li> <li>Ketepatan waktu pengumpulan tugas</li> <li><i>Correct in understanding, answers and analysis</i></li> <li><i>Able to explain the assignments</i></li> </ul>	<p><b>Non-Test :</b> <b>Tugas 2:</b> Mengerjakan soal-soal yang berhubungan dengan sistem, pengukuran, dan analisa gerak manusia</p> <p><b>Non-Test :</b> <b>Task 2:</b> <i>Solving the problems related to systems, measurements, and</i></p>	<ul style="list-style-type: none"> <li>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>]</li> <li><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>]</li> </ul>		<ul style="list-style-type: none"> <li>Sistem gerak manusia</li> <li>Pengukuran gerak manusia</li> <li>Analisa gerak manusia</li> </ul> <p>[<i>Link materi di MyITSClassroom</i>]</p> <ul style="list-style-type: none"> <li><i>Human motion system</i></li> <li><i>Measurement of human motion</i></li> </ul>	10



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</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 / Assessment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria &amp; Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		<ul style="list-style-type: none"> <li>On time submission of assignments</li> </ul>	<i>analysis of human motion</i>			<ul style="list-style-type: none"> <li>Human motion analysis</li> </ul> <p>[<i>Course materials link at MyITSClassroom</i>]</p>	
5-7	<p>Mahasiswa mampu memahami dan menganalisa fisiologi dari otot manusia menggunakan metode biomekanik sehingga dapat mendiagnosa movement disorder, menilai hasil rehabilitasi, dan mendesain teknologi rehabilitasi</p> <p><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></p>	<ul style="list-style-type: none"> <li>Kebenaran pemahaman, jawaban dan analisa</li> <li>Keberhasilan menjelaskan tugas</li> <li>Ketepatan waktu pengumpulan tugas</li> <li>Correct in understanding, answers and analysis</li> <li>Able to explain the assignments</li> <li>On time submission of assignments</li> </ul>	<p><b>Non-Tes :</b> <b>Tugas 3:</b> Mengerjakan soal yang berhubungan dengan:</p> <ul style="list-style-type: none"> <li>Contoh konsep pada fisiologi otot manusia</li> <li>Pengaruh intensitas penggunaan otot terhadap kekuatan otot</li> </ul> <p><b>Non-Test :</b> <b>Task 3:</b> Work on problems related to:</p>	<ul style="list-style-type: none"> <li>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>]</li> <li>Presentation, discussion, ask and answer, exercise, assignment [<i>FF: 3 x 3 x 50"</i>] [<i>SA: 3 x 3 x 50"</i>] [<i>SS: 3 x 3 x 50"</i>]</li> </ul>		<ul style="list-style-type: none"> <li>Dasar fisiologi otot manusia</li> <li>Muscle strength</li> <li>Muscle power</li> <li>Adaptation to reduced use</li> <li>Motor recovery after nervous system injury</li> <li>Adaptation with age</li> </ul> <p>[<i>Link materi di MyITSClassroom</i>]</p> <ul style="list-style-type: none"> <li>Basic physiology of human muscles</li> </ul>	15

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</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 / Assessment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria &amp; Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
(1)	(2)	(3)	(4)				
			<ul style="list-style-type: none"> <li>• <i>Examples of concepts on human muscle physiology</i></li> <li>• <i>Effect of intensity of use of muscles on muscle strength</i></li> </ul>			<ul style="list-style-type: none"> <li>• <i>Muscle strength</i></li> <li>• <i>Muscle power</i></li> <li>• <i>Adaptation to reduced use</i></li> <li>• <i>Motor recovery after nervous system injury</i></li> <li>• <i>Adaptation with age</i></li> </ul> <p><i>[Course materials link at MyITSClassroom]</i></p>	
8	<b>EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM</b>						20
9 - 12	<p>Mahasiswa mampu menganalisa dan mendesain teknik rehabilitasi berbasis Functional Electrical Stimulation, Robotik, dan Hybrid</p> <p><i>Students are able to analyze and design rehabilitation</i></p>	<ul style="list-style-type: none"> <li>• Kebenaran pemahaman, jawaban dan analisa</li> <li>• Keberhasilan menjelaskan tugas</li> <li>• Ketepatan waktu pengumpulan tugas</li> </ul>	<p><b>Non-Tes :</b></p> <p><b>Tugas 4:</b> Mengerjakan soal tentang aplikasi statika pada persendian tubuh manusia</p> <p><b>Tugas 5:</b></p>	<ul style="list-style-type: none"> <li>• Kuliah, diskusi, tanya jawab, latihan soal, tugas [TM: 4 x 3 x 50"] [BM: 4 x 3 x 50"] [PT : 4 x 3 x 50"]</li> <li>• <i>Presentation, discussion, ask and</i></li> </ul>		<ul style="list-style-type: none"> <li>• Definisi functional electrical stimulation, robotic rehabilitation, hybrid system</li> <li>• Desain functional electrical stimulation,</li> </ul>	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)	(5)	(6)	(7)	(8)
	<i>techniques based on Functional Electrical Stimulation, Robotic and Hybrid</i>	<ul style="list-style-type: none"> <li>• Correct in understanding, answers and analysis</li> <li>• Able to explain the assignments</li> <li>• On time submission of assignments</li> </ul>	<p>Merancang hardware dan software untuk sistem FES</p> <p><b>Non-Test :</b> <b>Task 4:</b> <i>Solving the problems about the application of statics to the joints of the human body</i></p> <p><b>Task 5:</b> <i>Design hardware and software for FES system</i></p>	<p><i>answer, exercise, assignment</i> [FF : 4 x 3 x 50"] [SA : 4 x 3 x 50"] [SS : 4 x 3 x 50"]</p>		<p>robotic rehabilitation, hybrid system</p> <ul style="list-style-type: none"> <li>• Rehabilitasi motorik</li> <li>• Fatigue</li> <li>• Aging</li> </ul> <p>[Link materi di MyITSClassroom]</p> <ul style="list-style-type: none"> <li>• Definition of functional electrical stimulation, robotic rehabilitation, hybrid system</li> <li>• Desain functional electrical stimulation, robotic rehabilitation, hybrid system</li> </ul>	


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</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 / Assessment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria &amp; Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)
(1)	(2)	(3)	(4)				
						<ul style="list-style-type: none"> <li>• <i>Rehabilitasi motorik</i></li> <li>• <i>Fatigue</i></li> <li>• <i>Aging</i></li> </ul> <p>[<i>Course materials link at MyITSClassroom</i>]</p>	
13 -14	<p>Mahasiswa memahami dan menganalisa efek obat-obatan pada rehabilitasi serta advocacy dari penggunaan obat-obatan tersebut</p> <p><i>Students understand and analyze the effects of drugs on rehabilitation and advocacy of the use of these drugs</i></p>	<ul style="list-style-type: none"> <li>• Kelengkapan dan kerapian hasil resume</li> <li>• Ketepatan waktu pengumpulan tugas</li> <li>• Kebenaran melaksanakan tugas</li> <li>• Keberhasilan menjelaskan tugas dengan baik</li> <li>• Kebenaran isi presentasi</li> <li>• Kelancaran dan keberhasilan menyampaikan materi</li> </ul>	<p><b>Non Tes:</b> <b>Tugas 6:</b></p> <ul style="list-style-type: none"> <li>• Resume tentang advocacy pada penggunaan obat-obatan untuk rehabilitasi</li> <li>• Presentasi tentang obat-obatan pada jenis rehabilitasi tertentu</li> </ul> <p><b>Non-Test:</b> <b>Task 6:</b></p>	<ul style="list-style-type: none"> <li>• 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>]</li> <li>• <i>Presentation, discussion, ask and answer, exercise, assignment</i> [<i>FF : 2 x 3 x 50"</i>] [<i>SA : 2 x 3 x 50"</i>] [<i>SS : 2 x 3 x 50"</i>]</li> </ul>		<ul style="list-style-type: none"> <li>• Obat-obatan pada rehabilitasi</li> <li>• Advokasi dari penggunaan obat-obatan untuk rehabilitasi</li> </ul> <p>[<i>Link materi di MyITSClassroom</i>]</p> <ul style="list-style-type: none"> <li>• <i>Medicines on rehabilitation</i></li> <li>• <i>Advocacy of the use of drugs for rehabilitation</i></li> </ul>	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 &amp; Techniques</i>	Tatap Muka / <i>In-class (5)</i>	Daring / <i>Online (6)</i>	(7)	(8)
(1)	(2)	(3)	(4)				
		<ul style="list-style-type: none"> <li>Laporan tertulis</li> <li><i>Completeness and neatness of the resume results</i></li> <li><i>Timeliness of submitting assignments</i></li> <li><i>Truth does the job</i></li> <li><i>Success in defining assignments well</i></li> <li><i>Correctness of presentation content</i></li> <li><i>Smoothness and success in delivering material</i></li> <li><i>Written report</i></li> </ul>	<ul style="list-style-type: none"> <li><i>Resumes about advocacy on the use of drugs for rehabilitation</i></li> <li><i>Presentations about drugs in certain types of rehabilitation</i></li> </ul>			[ <i>Course materials link at MyITSClassroom</i> ]	
15-16	<b>EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM</b>						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*

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

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
1	<b>Sub CP-MK 1:</b> Mahasiswa mampu memahami sejarah adanya teknik rehabilitasi  <b>LLO 1:</b> <i>Students are able to understand the history of rehabilitation engineering</i>	<b>Non-Tes :</b> <b>Tugas 1:</b> Resume mengenai sejarah teknik rehabilitasi dan jenis-jenis teknik rehabilitasi  <b>Tes:</b> ETS Soal 1 (5% dari ETS 20%)  <b>Non-Test :</b> <b>Task 1:</b> <i>Resume on the history of rehabilitation engineering and types of rehabilitation engineering</i>  <b>Test:</b> <i>Question 1 in Mid Exam (5% of Mid Exam 20%)</i>	5
2-4	<b>Sub CP-MK 2:</b> Mahasiswa mampu menjelaskan dan menganalisa aspek-aspek sistem gerak manusia antara yang sehat dan cacat dan mendiskusikan	<b>Non-Tes :</b> <b>Tugas 2:</b> Mengerjakan soal-soal yang berhubungan dengan sistem, pengukuran, dan analisa gerak manusia  <b>Tes:</b> ETS Soal 2 dan 3 (10% dari ETS 20%)	10

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	<p>penggunaannya dalam merancang teknik rehabilitasi</p> <p><b>LLO 2:</b> <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></p>	<p><b>Non-Test :</b> <b>Task 2:</b> <i>Solving the problems related to systems, measurements, and analysis of human motion</i></p> <p><b>Test:</b> <i>Question 2 and 3 in Mid Exam (10% of Mid Exam 20%)</i></p>	
5-7	<p><b>Sub CP-MK 3:</b> Mahasiswa mampu memahami dan menganalisa fisiologi dari otot manusia menggunakan metode biomekanik sehingga dapat mendiagnosa movement disorder, menilai hasil rehabilitasi, dan mendesain teknologi rehabilitasi</p> <p><b>LLO 3:</b> <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></p>	<p><b>Non-Tes :</b> <b>Tugas 3:</b></p> <ul style="list-style-type: none"> <li>- Mengerjakan soal yang berhubungan dengan contoh konsep pada fisiologi otot manusia</li> <li>- Mengerjakan soal yang berhubungan dengan pengaruh intensitas penggunaan otot terhadap kekuatan otot</li> </ul> <p><b>Tes:</b> ETS Soal 4 dan Soal 5 (5% dari ETS 20%) EAS Soal 1 (5% dari EAS 20%)</p> <p><b>Non-Test :</b> <b>Task 3:</b></p> <ul style="list-style-type: none"> <li>- <i>Solving the problems related to examples of concepts on human muscle physiology</i></li> <li>- <i>Solving the problems related to effect of intensity of use of muscles on muscle strength</i></li> </ul> <p><b>Test:</b> <i>Questions 4 and 5 in Mid Exam (5% of Mid Exam 20%)</i> <i>Question 1 in Final Exam (5% of Final Exam 20%)</i></p>	15
8	<p><b>Evaluasi Tengah Semester</b></p> <p><b>Mid Exam</b></p>	<p><b>Tes:</b> Ujian Tulis/Ujian Daring</p> <p><b>Test:</b> <i>Written Exams / Online Exams</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)
9-12	<p><b>Sub CP-MK 4:</b> Mahasiswa mampu menganalisa dan mendesain teknik rehabilitasi berbasis Functional Electrical Stimulation, Robotik, dan Hybrid</p> <p><b>LLO 4:</b> <i>Students are able to analyze and design rehabilitation techniques based on Functional Electrical Stimulation, Robotic and Hybrid</i></p>	<p><b>Non-Tes :</b> <b>Tugas 4:</b> Mengerjakan soal tentang aplikasi statika pada persendian tubuh manusia</p> <p><b>Tugas 5:</b> Merancang hardware dan software untuk sistem FES</p> <p><b>Tes:</b> EAS Soal No 2 dan 3 (10% dari EAS 20%)</p> <p><b>Non-test :</b> <b>Task 4:</b> <i>Solving the problems about the application of statics to the joints of the human body</i></p> <p><b>Task 5:</b> <i>Design hardware and software for FES system</i></p> <p><b>Test:</b> <i>Question 2 and 3 in Final Exam (10% of Final Exam 20%)</i></p>	20
13-14	<p><b>Sub CP-MK 5:</b> Mahasiswa memahami dan menganalisa efek obat-obatan pada rehabilitasi serta advocacy dari penggunaan obat-obatan tersebut</p> <p><b>LLO 5:</b> <i>Students understand and analyze the effects of drugs on rehabilitation and advocacy of the use of these drugs</i></p>	<p><b>Non-Tes :</b> <b>Tugas 6:</b></p> <ul style="list-style-type: none"> <li>- Resume tentang advocacy pada penggunaan obat-obatan untuk rehabilitasi</li> <li>- Presentasi tentang obat-obatan pada jenis rehabilitasi tertentu</li> </ul> <p><b>Tes:</b> EAS Soal No 4 dan 5 (5% dari EAS 20%)</p> <p><b>Non-Test:</b> <b>Task 6:</b></p> <ul style="list-style-type: none"> <li>- <i>Resumes about advocacy on the use of drugs for rehabilitation</i></li> <li>- <i>Presentations about drugs in certain types of rehabilitation</i></li> </ul> <p><b>Test:</b> <i>Question 4 and 5 in Final Exam (5% of Final Exam 20%)</i></p>	10

<b>Mg ke/ Week (1)</b>	<b>Sub CP-MK / Lesson Learning Outcomes (LLO) (2)</b>	<b>Bentuk Asesmen (Penilaian) Form of Assessment (3)</b>	<b>Bobot / Load (%) (4)</b>
15-16	Evaluasi Akhir  <i>Final Exam</i>	<b>Tes:</b> Ujian Tulis/Ujian Daring  <b>Test:</b> <i>Written Exams / Online Exams</i>	20
<b>Total bobot penilaian Total assessment load</b>			100%

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

<b>CPL yang dibebankan pada MK / <i>PLO charged to the course</i></b>	<b>CPMK / <i>Course Learning Outcome (CLO)</i></b>	<b>Minggu ke / <i>Week</i></b>	<b>Bentuk Asesmen / <i>Form of Assessment</i></b>	<b>Bobot / <i>Load (%)</i></b>
CPL-02 / PLO-02	CPMK 1 / CLO 1	Week- 1	Task 1	5
		Week- 8	Mid Exam Question 1	5
	CPMK 2 / CLO 2	Week- 2-4	Task 2	10
		Week- 8	Mid Exam Question 2 and 3	10
CPL-05 / PLO-05	CPMK 4 / CLO 4	Week- 9-12	Task 4 and 5	20
		Week- 16	Final Exam Question 2 and 3	10
CPL-06 / PLO-06	CPMK 3 / CLO 3	Week- 5-7	Task 3	15
		Week- 8	Mid Exam Question 4 and 5	5
		Week- 16	Final Exam Question 1	5
CPL-08 / PLO-08	CPMK 5 / CLO 5	Week- 13-14	Task 6	5
		Week- 13-14	Presentation	5
	CPMK 6 / CLO 6	Week- 16	Final Exam Question 4 and 5	5
				<b>Σ = 100%</b>



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	Task 1		0.05											0.05
2	Task 2		0.1											0.1
3	Task 3						0.15							0.15
4	Task 4					0.05								0.05
5	Task 5					0.15								0.15
6	Task 6								0.05					0.05
7	Presentation								0.05					0.05
8	Mid Exam		0.15				0.05							0.2
9	Final Exam					0.1	0.05		0.05					0.2
	Total		0.3			0.3	0.25		0.15					1



**BIOMEDICAL ENGINEERING ITS**

**2023-2024**