



Bachelor Degree Program Department of Biomedical Engineering

Faculty of Intelligent Electrical Technology and Informatics
Institut Teknologi Sepuluh Nopember



MODULE HANDBOOK
Clinical Engineering
DEPARTMENT OF BIOMEDICAL ENGINEERING
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
Number : 6835/IT2.IX.5.1.2/B/PP.03.00.00/2023

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>	Eko Agus Suprayitno, S.Si, 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

MODULE HANDBOOK

CLINICAL ENGINEERING

Module name	Clinical Engineering	
Module level	Undergraduate	
Code	EB234601	
Course (if applicable)	Clinical Engineering	
Semester	Second Semester (Genap)	
Person responsible for the module	Achmad Arifin, S.T., M.Eng., Ph.D.	
Lecturer	Achmad Arifin, S.T., M.Eng., Ph.D. Rezki El Arif, S.T., M.T., Ph.D	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, mandatory , 6 th semester.	
Type of teaching, contact hours	Lectures, <60 students Tuesdays, 11.00-12.50 (GMT+7)	
Workload	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.	
Credit points	2 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 Instrumentations and Laboratory	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO1: Students are able to explain the scope of clinical engineering.	PLO-02

	CLO2: Students are able to provide quality assessments and equipment development CLO3: Students are able to explain the Regulatory Framework which includes risk analysis, responsibility, technical safety and handling of accidents due to equipment CLO4: Students are able to prepare planning procedures and procurement of medical equipment CLO5: Students are able to devise methods of maintaining, storing and disposing medical equipment	PLO-10 PLO-06 PLO-05 PLO-05
Content	The Clinical Engineering course provides knowledge about the scope of clinical engineering in hospitals and health facilities including assessment administration, acquisition, and utilization of health technology.	
Study and examination requirements and forms of examination	• Written Assignment 1, 2, 3 • Presentation 1,2 • Mid-term examination • Final examination	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	
Reading list	Main : 1. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph D. Bronzino ed. Clinical Engineering, Principles and Applications in Engineering Series. CRC Press, Boca Raton, 2003. 2. Joseph F. Dyro ed. Clinical Engineering Handbook. Elsevier Academic Press, USA, 2004. 3. Azzam F G Taktak, Paul Ganney, David Long, Paul White ed. Clinical Engineering: A Handbook for Clinical and Biomedical Engineers. Elsevier Academic Press, UK, 2014. Supporting : 1. Roberto Miniati, Ernesto Iadanza, Fabrizio Dori. Clinical Engineering: From Devices to Systems. Elsevier Academic Press, USA, 2016.	

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 Klinika <i>Clinical Engineering</i>	EB234601	Ilmu Dasar Teknik <i>Basic Engineering</i>	T=2	P=0	VI	Nov 9, 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.)		(Dr. Rachmad Setiawan, S.T., M.T.)		(Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to The Course</i>					
	CPL-02 <i>PLO-02</i>	Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang Teknik Biomedik, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis, sistematis, dan inovatif <i>Able to study and utilize science and technology in order to apply it to the field of Biomedical Engineering and able to make appropriate decisions from the results of one's own work or group work in the form of final assignment reports or forms of learning activities others whose output is equivalent to the final assignment through logical, critical, systematic and innovative thinking.</i>				
	CPL-05	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.				

	PLO-05	<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 PLO-06	Mampu merancang dan melaksanakan eksperimen laboratorium dan/atau lapangan, menganalisa dan menginterpretasi data, serta menggunakan penilaian yang obyektif untuk menarik kesimpulan. <i>Able to design and implement laboratory experiment and / or field experiments, analyze and interpret data, and use objective assessments to draw conclusions.</i>
	CPL-10 PLO-10	Mampu bekerja dalam tim lintas disiplin dan budaya serta bertanggung jawab kepada masyarakat dan mematuhi hukum dan etika profesi dalam menyelesaikan masalah Teknik Biomedika. <i>Able to work in interdisciplinary and intercultural teams and be responsible to the community and comply with legal and professional ethics in solving Biomedical Engineering problems.</i>
Capaian Pembelajaran Mata Kuliah (CPMK) 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 menjelaskan ruang lingkup teknik klinika. <i>Students are able to explain the scope of clinical engineering.</i>
	CP MK 2 CLO 2	Mahasiswa mampu memberikan penilaian kualitas dan pengembangan peralatan . <i>Students are able to provide quality assessments and equipment development.</i>
	CP MK 3 CLO 3	Mahasiswa mampu menjelaskan Framework Regulasi yang meliputi Analisis resiko, tanggung jawab, keselamatan teknis dan penanganan kecelakaan akibat peralatan. <i>Students are able to explain the Regulatory Framework which includes risk analysis, responsibility, technical safety and handling of accidents due to equipment.</i>
	CP MK 4 CLO 4	Mahasiswa mampu menyiapkan prosedur perencanaan dan pengadaan peralatan medis. <i>Students are able to prepare planning procedures and procurement of medical equipment.</i>
	CP MK 5 CLO 5	Mahasiswa mampu menyusun metode pemeliharaan, penyimpanan dan pemusnahan peralatan medis. <i>Students are able to devise methods of maintaining, storing and disposing medical equipment.</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 <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>					√							
Diskripsi Singkat MK Short Description of Course	Mata kuliah Teknik Klinika memberikan pengetahuan tentang ruang lingkup teknik klinika di rumah sakit dan fasilitas kesehatan yang meliputi administrasi asesmen, akuisisi, dan utilisasi teknologi kesehatan. <i>The Clinical Engineering course provides knowledge about the scope of clinical engineering in hospitals and health facilities including assessment administration, acquisition, and utilization of health technology.</i>												

Bahan Kajian: Materi pembelajaran Course Materials:		1. Ruang lingkup teknik klinika / <i>The scope of clinical engineering</i> 2. Penilaian kualitas dan pengembangan peralatan / <i>Quality assessment and equipment development</i> 3. Framework Regulasi: Analisis risiko, tanggung jawab, keselamatan teknis dan penanganan kerusakan peralatan / <i>Regulatory Framework: Analysis of risks, responsibilities, technical safety and handling of equipment damage</i> 4. Prosedur perencanaan dan pengadaan peralatan medis / <i>Medical equipment planning and procurement planning procedures</i> 5. Metode pemeliharaan, penyimpanan dan pemusnahan peralatan medis / <i>Methods of maintenance, storage and disposal of medical equipment</i>					
Pustaka References		Utama / Main:					
		1. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph D. Bronzino ed. Clinical Engineering, Principles and Applications in Engineering Series. CRC Press, Boca Raton, 2003. 2. Joseph F. Dyro ed. Clinical Engineering Handbook. Elsevier Academic Press, USA, 2004. 3. Azzam F G Taktak, Paul Ganney, David Long, Paul White ed. Clinical Engineering: A Handbook for Clinical and Biomedical Engineers. Elsevier Academic Press, UK, 2014.					
		Pendukung / Supporting:					
		1. Roberto Miniati, Ernesto Iadanza, Fabrizio Dori. Clinical Engineering: From Devices to Systems. Elsevier Academic Press, USA, 2016.					
Dosen Pengampu Lecturers		Dr. Tri Arief Sardjono, S.T., M.T.					
Matakuliah syarat Prerequisite		Instrumentasi Biomedika dan Laboratorium <i>Biomedical Instrumentations 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>				
(1)	(2)	(3)	(4)	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	(8)

1 - 2	Mahasiswa mampu menjelaskan ruang lingkup teknik klinika <i>Students are able to explain the scope of clinical engineering.</i>	• Kelengkapan dan kerapian hasil laporan presentasi • Ketepatan menjelaskan pemahaman materi • <i>Completeness and neatness of the results of the presentation report</i> • <i>Accuracy in explaining understanding of the material</i>	Non-tes : Presentasi 1 Non-test : Presentation 1	• Kuliah, diskusi dan presentasi [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] • <i>Lecture, discussion, and presentation</i> [FF : 2 x 50"] [SA : 2 x 50"] [SS : 2 x 50"]	• Chatting dan diskusi dalam forum platform ITS. • <i>Chat and discussion in ITS platform forum.</i>	• Ruang lingkup teknik klinika • <i>The scope of clinical engineering</i>	10
3-4	Mahasiswa mampu memberikan penilaian kualitas dan pengembangan peralatan. <i>Students are able to provide quality assessments and equipment development.</i>	• Ketepatan waktu pengumpulan tugas. • Kebenaran melaksanakan tugas. • Keberhasilan menjelaskan tugas. • Kebenaran jawaban dan analisis.	Non-tes : Tugas 1 Non-test : Task 1	• Kuliah, diskusi dan tugas [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] • <i>Lecture, discussion, and assignment</i> [FF : 2 x 50"] [SA : 2 x 50"] [SS : 2 x 50"]		• Penilaian kualitas dan pengembangan peralatan • <i>Quality assessment and equipment development</i>	5

		• <i>On time submission of assignments</i> • <i>Correct assignment work.</i> • <i>Success of explaining assignments.</i> • <i>Correct answers and analysis.</i>					
5 - 7	Mahasiswa mampu menjelaskan Framework Regulasi yang meliputi Analisis resiko, tanggung jawab, keselamatan teknis dan penanganan kecelakaan akibat peralatan Students are able to explain the Regulatory. <i>Framework which includes risk analysis, responsibility, technical safety and handling of accidents due to equipment.</i>	• Kelengkapan dan kerapian hasil laporan presentasi • Ketepatan menjelaskan pemahaman materi • <i>Completeness and neatness of the results of the presentation report</i> • <i>Accuracy in explaining understanding of the material</i>	Non-tes : Presentasi 2 Non-test : Presentation 2	• Kuliah, diskusi dan presentasi [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] • <i>Lecture, discussion, and presentation</i> [FF : 2 x 50"] [SA : 2 x 50"] [SS : 2 x 50"]		• Framework Regulasi: Analisis risiko, tanggung jawab, keselamatan teknis dan penanganan kerusakan peralatan. • <i>Regulatory Framework: Analysis of risks, responsibilities, technical safety and handling of equipment damage.</i>	10
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						25

9 - 11	Mahasiswa mampu menyiapkan prosedur perencanaan dan pengadaan peralatan medis. <i>Students are able to prepare planning procedures and procurement of medical equipment.</i>	• Ketepatan waktu pengumpulan tugas. • Kebenaran melaksanakan tugas. • Keberhasilan menjelaskan tugas. • Kebenaran jawaban dan analisis. • <i>On time submission of assignments</i> • <i>Correct assignment work.</i> • <i>Success of explaining assignments.</i> • <i>Correct answers and analysis.</i>	Non-tes : Tugas 2 Non-test : Task 2	• Kuliah, diskusi dan tugas [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] • <i>Lecture, discussion, and assignment</i> [FF : 2 x 50"] [SA : 2 x 50"] [SS : 2 x 50"]		• Prosedur perencanaan dan pengadaan peralatan medis. • <i>Medical equipment planning and procurement planning procedures.</i>	10
12 -14	Mahasiswa mampu menyusun metode pemeliharaan, penyimpanan dan pemusnahan peralatan medis. <i>Students are able to devise methods of maintaining,</i>	• Ketepatan waktu pengumpulan tugas. • Kebenaran melaksanakan tugas.	Non tes: Tugas 3 Non-test: Task 3	• Kuliah, diskusi dan tugas [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"]		• Metode pemeliharaan, penyimpanan dan pemusnahan peralatan medis • <i>Methods of maintenance,</i>	10

	storing and disposing medical equipment.	● Keberhasilan menjelaskan program. ● Kebenaran jawaban dan analisis. ● On time submission of assignments ● Correct assignment work. ● Success of explaining programs. Correct answers and analysis.		● Lecture, discussion, and assignment [FF : 2 x 50"] [SA : 2 x 50"] [SS : 2 x 50"]		storage and disposal of medical equipment	
15-16	EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM						30

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 : Clinical Engineering		RA& E
			Write Doc Code
Kode/code: EB234601	Bobot sks/credits (T/P): 3/0	Rumpun MK: Ilmu Dasar Teknik Course Cluster: Basic Engineering	Smt: VI
OTORISASI AUTHORIZATION	Penyusun RA & E Compiler A&EP Dr. Achmad Arifin, S.T., M.Eng.	Koordinator RMK Course Cluster Coordinator Dr. Rachmad Setiawan, S.T., M.T.	Ka DEP Head of DEP Dr. Achmad Arifin, S.T., M.Eng.

Mg ke/ Wee k (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
1-2	Sub CP-MK 1: Mahasiswa mampu menjelaskan ruang lingkup teknik klinika LLO 1: <i>Students are able to explain the scope of clinical engineering.</i>	Non-tes : Presentasi 1 Tes: 1 Soal Pada ETS (10% dari ETS 25%) Non-test : Presentation 1 Test: 1 question on Mid Exam (10% of Mid Exam 25%)	10
3-4	Sub CP-MK 2: Mahasiswa mampu memberikan penilaian kualitas dan	Non-tes : Tugas 1 Tes: 1 Soal Pada ETS (12.5% dari ETS 25%) Non-test :	5

	pengembangan peralatan LLO 2: <i>Students are able to provide quality assessments and equipment development.</i>	Task 1 Test: <i>1 Question in Mid Exam (15% of Mid Exam 15%)</i>	
5-7	Sub CP-MK 3: Mahasiswa mampu menjelaskan Framework Regulasi yang meliputi Analisis resiko, tanggung jawab, keselamatan teknis dan penanganan kecelakaan akibat peralatan LLO 3: <i>Students are able to explain the Regulatory Framework which includes risk analysis, responsibility, technical safety and handling of accidents due to equipment</i>	Non-tes : Presentasi 2 Tes: 3 Soal Pada ETS (27.5% dari ETS 25%) Non-test : Presentation 2 Test: <i>3 Question in Mid Exam (27.5% of Mid Exam 25%)</i>	10
8	Evaluasi Tengah Semester Mid Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Writing Exams / Online Exams</i>	25
9-11	Sub CP-MK 4: Mahasiswa mampu menyiapkan prosedur perencanaan dan	Non-tes : Tugas 2 Tes: 3 Soal Pada EAS (25% dari EAS 30%)	10

	pengadaan peralatan medis LLO 4: <i>Students are able to prepare planning procedures and procurement of medical equipment</i>	Non-test : Task 2 Test: <i>3 Question in Final Exam (25% of Final Exam 30%)</i>	
12-1 4	Sub CP-MK 5: Mahasiswa mampu menyusun metode pemeliharaan, penyimpanan dan pemusnahan peralatan medis LLO 5: <i>Students are able to devise methods of maintaining, storing and disposing medical equipment</i>	Non-tes : Tugas 3 Tes: <i>3 Soal Pada EAS (25% dari EAS 30%)</i> Non-test: Task 3 Test: <i>3 Question in Final Exam (25% of Final Exam 30%)</i>	10
15-1 6	Evaluasi Akhir Final Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Writing Exams / Online Exams</i>	30
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-02 / PLO-02	CPMK 3 / CLO 3	Week 5-7	Presentation 2	10
		Week 8	Mid Exam 3 Question	13.75
CPL-05 / PLO-05	CPMK 1 / CLO 1	Week- 1-2	Presentation 1	10
		Week- 8	Mid Exam 1 Question	5
CPL-06 / PLO-06	CPMK 4 / CLO 4	Week 9-11	Task 2	10
		Week 15-16	Final Exam 3 Question	15
	CPMK 5 / CLO 5	Week 12-14	Task 3	10
		Week 15-16	Final Exam 3 Question	15
CPL-10 / PLO-10	CPMK 2 / CLO 2	Week 3-4	Task 1	5
		Week 8	Mid Exam 1 Question	6.25
				$\Sigma = 100\%$

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 (Tugas		0.10								0.15			0.25

	<i>Tertulis 1, Presentasi 1)</i> <i>Assignment 1 (Written Assignment 1, Presentation 1)</i>													
2	<i>Tugas 2 (Tugas Tertulis 2, Evaluasi Tengah Semester)</i> <i>Assignment 2 (Written Assignment 2, Mid Term Exam)</i>		0.10				0.10				0.05			0.25
3	<i>Tugas 3 (Tugas Tertulis 3, Presentasi 2)</i> <i>Assignment 3</i>					0.20	0.05							0.25

	(Written Assignment 3, Presentation 2)													
4	Tugas 4 (Evaluasi Akhir Semester) Assignment 4 (Final Exam)					0.20	0.05							0.25
	<i>Total</i>		0.20			0.40	0.20				0.20			1