MODULE HANDBOOK

BIOMAGNETIC ENGINEERING

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

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

ENDORSEMENT PAGE

	MODULE HANDBOOK **Biomagnetic Engineering** **DEPARTMENT OF BIOMEDICAL ENGINEERING** **INSTITUT TEKNOLOGI SEPULUH NOPEMBER** **Number :** B/21363/IT2.IX.5.1.2/PP.03.00.00/2020

Proses ***Process***	**Penanggung Jawab** ***Person in Charge***			**Tanggal** ***Date***
	Nama ***Name***	**Jabatan** ***Position***	**Tandatangan** ***Signature***	
Perumus *Preparation*	Eko Setijadi, ST, MT, PhD	Dosen *Lecturer*	**TTD**	**November 23, 2019**
Pemeriksa dan Pengendalian *Review and Control*	M. Hilman Fatoni, S.T., M.T.	Tim kurikulum *Curriculum team*		**February 12, 2020**
Persetujuan *Approval*	Dr. Rachmad Setiawan, S.T., M.T.	Koordinator RMK *Course Cluster Coordinator*		**March 04, 2020**
Penetapan *Determination*	Dr. Achmad Arifin, S.T., M.Eng.	Kepala Departemen *Head of Department*		**March 11, 2020**

+

MODULE HANDBOOK
BIOMAGNETIC ENGINEERING

Module name	**Biomagnetic Engineering**
Module level	Undergradute
Code	EB184601
Course (if applicable)	Biomagnetic Engineering
Semester	Sixth Semester (Genap)
Person responsible for the module	Eko Setijadi, ST, MT, PhD
Lecturer	Eko Setijadi, ST., MT., Ph.D
Language	Bahasa Indonesia and English
Relation to curriculum	Undergradute degree program, **mandatory**, 6th semester.
Type of teaching, contact hours	Lectures, <60 students
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	EB184304 – Engineering Mathematics
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO 1: Students are able to understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited CLO 2: Students are able to understand the theory and basic equations concerning bioelectromagnetic phenomena CLO 3: Students are able to understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering.
Content	The scope of discussion on the basics of biomagnetic engineering which backgrounds the biomedical phenomenon on living things body and its application on biomedical engineering field
Study and examination	• In-class exercises • Assignment 1, 2, 3, 4, 5

requirements and forms of examination	• Mid-term examination • Final examination
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.
Reading list	Main : 1. Jaakko Malmivuo, Robert Plonsey, “Bioelectromagnetism: Principles and Applications of Bioelectric and Biomagnetic Fields”, Oxford University Press, 1995. Available online di: http://www.bem.fi/book

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) *COURSE*	KODE *CODE*	Rumpun MK *Course Cluster*	BOBOT (sks) Credits		SEMESTER	Tgl Penyusunan *Compilation Date*
Teknik Biomagnetika ***Biomagnetic Engineering***	EB184601	Biomedical Instrumentation and Signal Processing	T=3	P=0	VI	Feb 27, 2020

OTORISASI / PENGESAHAN *AUTHORIZATION / ENDORSEMENT*	Dosen Pengembang RPS *Developer Lecturer of Semester Learning Plan*	Koordinator RMK *Course Cluster Coordinator*	Ka DEPARTEMEN *Head of Department*
	(Eko Setijadi, ST, MT, PhD)	**(Dr. Rachmad Setiawan, S.T., M.T.)**	**(Dr. Achmad Arifin, S.T., M.Eng.)**

Capaian Pembelajaran ***Learning Outcomes***	**CPL-PRODI yang dibebankan pada MK** ***PLO Program Charged to The Course***	
	CPL-01 **LLO-01**	Mampu **menerapkan** Ilmu Pengetahuan Alam dan Matematika pada bidang Teknik Biomedika *Able to **apply** Natural Sciences and Mathematics in the field of Biomedical Engineering*
	CPL-02 **LLO-02**	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 *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*

	CPL-06 **LLO-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*
	CPL-08 **LLO-08**	Mampu **bekerja dalam tim** lintas disiplin dan budaya serta **bertanggung jawab** kepada masyarakat dan **mematuhi hukum dan etika profesi** dalam menyelesaikan masalah Teknik Biomedika *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*
	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 memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis. *Students are able to understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited*
	CP MK 2 ***CLO 2***	Mahasiswa memahami teori dan persamaan-persamaan dasar yang menyangkut fenomena-fenomena bioelektromagnetik. *Students are able to understand the theory and basic equations concerning bioelectromagnetic phenomena*
	CP MK 3 ***CLO 3***	Mahasiswa memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik. *Students are able to understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering.*

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*		√						√				

Diskripsi Singkat MK

Short Description of Course

Cakupan bahasan tentanag dasar-dasar teknik biomagnetika yang melatarbelakangi fenomena-fenomena biomedis pada tubuh mahluk hidup, dan aplikasinya pada bidang teknik biomedika

The scope of discussion on the basics of biomagnetic engineering which backgrounds the biomedical phenomenon on living things body and its application on biomedical engineering field

Bahan Kajian:
Materi pembelajaran

Course Materials:

1. Dasar medan listrik dan medan magnet /*Basic electrical field and magnetic field*
2. Pengenalan Biomagnetisme /*Introduction to Biomagnetism*
3. Pengukuran Biomagnetisme / *Biomagnetism Measurement*
4. Prinsip Magnetic Resonance Imaging / *Magnetic Resonance Imaging Principle*
5. Impedansi Biomagnetik / *Biomagnetic Impedance*
6. Prospek MRI menggunakan Impedance dan arus listrik /*MRI prospect with using impedance and electrical current*
7. Efek medan elektromagnetik pada jaringan biologis /*Electromagnetic field effect on biological tissue*
8. Aspek Keselamatan pada medan Elektromagnetik /*Safety aspect on electromagnetic field*

Pustaka ***References***	**Utama / *Main*:** 1. Jaakko Malmivuo, Robert Plonsey, "Bioelectromagnetism: Principles and Applications of Bioelectric and Biomagnetic Fields", Oxford University Press, 1995. Available online di: http://www.bem.fi/book **Pendukung / *Supporting*:**
Dosen Pengampu ***Lecturers***	Eko Setijadi, ST., MT., Ph.D
Matakuliah syarat ***Prerequisite***	EB184304 - Matematika Teknik *EB184304 – Engineering Mathematics*

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 /*Assess-ment Load* (%)**
		Indikator / *Indicator*	**Kriteria & Teknik / *Criteria & Techniques***				
(1)	**(2)**	**(3)**	**(4)**	**Tatap Muka / *In-class* (5)**	**Daring / *Online* (6)**	**(7)**	**(8)**

1-3	Mahasiswa memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis. *Students understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited*	• Memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis. • *Understand the basic of anatomy and physiology of body tissur that can be electromagnetically excited*	**Non-tes :** **Tugas Tertulis 1:** Mengerjakan soal-soal teori dan perhitungan terkait medan listrik, medan magnet **Tugas Tertulis 2:** Resume mengenai Biomagnetisme ***Non-test :*** ***Written Assignment 1:*** *Working on theory and calculation questions regarding electrical field, magnetic field* ***Written Assignment 2:*** *Resume regarding Biomagnetism*	• Kuliah dan brainstorming, tanya jawab. [TM : 3 x 50”] [BM : 3 x 50”] [PT : 3 x 50”] • *Presentation and brainstorming, ask and answer.* *[FF : 3 x 50”]* *[SA : 3 x 50”]* *[SS : 3 x 50”]*	• Chatting dan diskusi dalam forum platform ITS. • *Chat and discussion in ITS platform forum.*	• Dasar medan listrik dan medan magnet • Pengenalan Biomagnetisme • *Basic electrical field and magnetic field* • *Introduction to Biomagnetism*	**Tugas 1: 5** **Tugas 2: 5** ***Assignment 1: 5*** ***Assignment 2: 5***
4-7	Mahasiswa memahami teori dan persamaan-persamaan dasar yang menyangkut	• Memahami teori dan persamaan-persamaan dasar yang menyangkut	**Non-tes :** **Tugas Tertulis 3:** Mengerjakan soal-	• Kuliah, diskusi, tanya jawab, latihan soal, tugas.		• Pengukuran Biomagnetisme	**Tugas 3: 5**

	fenomena-fenomena bioelektromagnetik. *Students understand the theory and basic equations concerning bioelectromagnetic phenomena*	fenomena-fenomena bioelektromagnetik • *Understand the theory and basic equations concerning bioelectromagnetic phenomena*	soal teori, aplikasi dan perhitungan biomagnetisme pada tubuh manusia ***Non-test :*** ***Written Assignment 3:*** *Working on biomagnetism in the human body theory, application, and calculation questions*	[TM : 2 x 50”] [BM : 2 x 50”] [PT : 2 x 50”] • *Presentation, discussion, ask and answer, exercise, assignment* *[FF : 3 x 50”]* *[SA : 3 x 50”]* *[SS : 3 x 50”]*		• *Biomagnetism Measurement*	***Assignment 3: 5***
	EVALUASI TENGAH SEMESTER ***MID-SEMESTER EXAM***						**30**
9-14	Mahasiswa memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik.	• Memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik	**Non-tes :** **Tugas Tertulis 4:** Mengerjakan soal-soal teori, aplikasi dan perhitungan yang mendasari	• Kuliah, diskusi, tanya jawab, latihan soal, tugas [TM : 2 x 50”] [BM : 2 x 50”] [PT : 2 x 50”]		• Prinsip *Magnetic Resonance Imaging* • Impedansi Biomagnetik • Prospek MRI menggunakan	**Tugas 4: 5** **Tugas 5: 20**

	Students understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering	• *Understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering*	instrument MRI, impedansi biomagnetik, serta prospek penggunaan di masa depan **Tugas Presentasi :** Presentasi secara individu mengenai efek medan elektromagnetik pada jaringan tubuh dan keselamatan pada medan elektromagnetik ***Non-test : Written Assignment 4:*** *Working on theory, application, and calculation which underlie MRI instrument, biomagnetic*	• *Presentation, discussion, ask and answer, exercise, assignment [FF : 4 x 50"] [SA : 4 x 60"] [SS : 4 x 60"]*		Impedance dan arus listrik • Efek medan elektromagnetik pada jaringan biologis • Aspek Keselamatan pada medan Elektromagnetik • *Magnetic Resonance Imaging Principal* • *Biomagnetic Impedance* • *MRI prospect using Impendance and electrical current* • *Electromagnetic field effect on biological tissue* • *Safety Aspect on Electromagnetic field*	***Assignment 4:*** ***5*** ***Assignment 5:*** ***20***

			impedance and future use prospect ***Presentation Assignment :*** *Individual presentation regarding electromagnetic field effect in the body tissue and safety on electromagnetic field*				
15-16	**EVALUASI TENGAH SEMESTER** ***FINAL SEMESTER EXAM***						**30**

TM=Tatap Muka, **PT**=Penugasan Terstuktur, **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 : Biomagnetic Engineering**		**RA&E** Write Doc Code
Kode/*code*: **EB184601**	**Bobot sks/*credits* (T/P): 3/0**	**Rumpun MK: Biomedical Instrumentation and Signal Processing** ***Course Cluster: Biomedical Instrumentation and Signal Processing***	Smt: VI
OTORISASI ***AUTHORIZATION***	**Penyusun RA & E** ***Compiler A&EP*** **Eko Setijadi, ST, MT, PhD**	**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/ *Week* (1)	**Sub CP-MK / *Lesson Learning Outcomes (LLO)* (2)**	**Bentuk Asesmen (Penilaian)** ***Form of Assessment*** **(3)**	**Bobot / *Load* (%) (4)**
1-3	**Sub CP-MK 1:** Mahasiswa memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis. ***LLO 1:*** *Students understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited*	**Non-tes :** **Tugas 1:** Mengerjakan soal-soal teori dan perhitungan terkait medan listrik, medan magnet **Tugas 2:** Resume mengenai Biomagnetisme **Tes:** 1 Soal pada ETS ***Non-test :*** ***Task 1:*** *Working on theory and calculation questions regarding electrical field, magnetic field* ***Task 2:*** *Resume regarding Biomagnetism* ***Test:*** *1 Question on Mid-semester Exam*	20
4-7	**Sub CP-MK 2:** Mahasiswa memahami teori dan persamaan-persamaan dasar	**Non-tes :** **Tugas 3:** Mengerjakan soal-soal teori, aplikasi dan perhitungan biomagnetisme pada tubuh manusia **Tes:**	25

Mg ke/ *Week* (1)	Sub CP-MK / *Lesson Learning Outcomes (LLO)* (2)	Bentuk Asesmen (Penilaian) *Form of Assessment* (3)	Bobot / *Load* (%) (4)
	yang menyangkut fenomena-fenomena bioelektromagnetik. ***LLO 2:*** *Students understand the theory and basic equations concerning bioelectromagnetic phenomena*	1 Soal pada ETS ***Non-test :*** ***Task 3:*** *Working on biomagnetism in the human body theory, application, and calculation questions* ***Test:*** *1 Question on Mid-semester Exam*	
8	**Evaluasi Tengah Semester** ***Mid Exam***	**Tes:** Ujian Tulis/Ujian Daring ***Test:*** *Writing Exams / Online Exams*	30
9-14	**Sub CP-MK 3:** Mahasiswa memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik. ***LLO 3:*** *Students understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering*	**Non-tes :** **Tugas 4:** Mengerjakan soal-soal teori, aplikasi dan perhitungan yang mendasari instrument MRI, impedansi biomagnetik, serta prospek penggunaan di masa depan **Tugas Demo dan Laporan:** Presentasi secara individu mengenai efek medan elektromagnetik pada jaringan tubuh dan keselamatan pada medan elektromagnetik **Tes:** 2 Soal pada EAS ***Non-test :*** ***Task 4:*** *Working on theory, application, and calculation which underlie MRI instrument, biomagnetic impedance and future use prospect* ***Demo Assignment and Reports:*** *Individual presentation regarding electromagnetic field effect in the body tissue and safety on electromagnetic* ***Test:*** *2 Question on Final Exam*	55
15-16	**Evaluasi Akhir** ***Final Exam***	**Tes:** Ujian Tulis/Ujian Daring ***Test:*** *Writing Exams / Online Exams*	30
		Total bobot penilaian	**100%**

Mg ke/ *Week* (1)	Sub CP-MK / *Lesson Learning Outcomes (LLO)* (2)	Bentuk Asesmen (Penilaian) *Form of Assessment* (3)	Bobot / *Load* (%) (4)
		Total assessment load	

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

CPL yang dibebankan pada MK / *PLO charged to the course*	CPMK / *Course Learning Outcome (CLO)*	Minggu ke / *Week*	Bentuk Asesmen / *Form of Assessment*	Bobot / *Load* (%)
CPL-01 / *PLO-01*	CPMK 1 / *CLO 1*	*Week- 1-3*	*Task 1*	10
		Week- 1-3	*Task 2*	10
		Week- 8	*1 Question on Mid Exam*	15
CPL-02 / *PLO-02*	CPMK 3 / *CLO 3*	*Week- 9-14*	*Task 4*	13.75
		Week- 9-14	*Demo Assignment*	13.75
		Week- 16	*2 Question on Final Exam*	15
CPL-06 / *PLO-06*	CPMK 2 / *CLO 2*	*Week- 4-7*	*Task 3*	25
		Week- 8	*1 Question on Mid Exam*	15
CPL-08 / *PLO-08*	CPMK 3 / *CLO 3*	*Week- 9-14*	*Task 4*	13.75
		Week- 9-14	*Demo Assignment*	13.75
	CPMK 6 / *CLO 6*	*Week- 16*	*2 Question on Final Exam*	15
				∑ = 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	*Task 1*	0.1												**0.1**
2	*Task 2*	0.1												**0.1**
3	*Task 3*						0.25							**0.25**
4	*Task 4*		0.1375						0.1375					**0.275**
5	*Demo Assignment*		0.1375						0.1375					**0.275**
6	*Mid Exam*	0.15					0.15							**0.3**

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*
7	*Final Exam*		0.15						0.15					**0.3**
	Total	0.35	0.425				0.4		0.425					**1**