



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 : 6823/IT2.IX.5.1.2/B/PP.03.00.00/2023

| Proses Process | Penanggung Jawab Person in Charge | | | Tanggal Date |
|----------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------|
| | Nama Name | Jabatan Position | Tandatangan Signature | |
| Perumus <i>Preparation</i> | Eko Setijadi, ST, MT, PhD | Dosen <i>Lecturer</i> | TTD | November 18, 2022 |
| Pemeriksa dan Pengendalian <i>Review and Control</i> | Dr. Norma Hermawan, S.T., M.Sc. | 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

BIOMAGNETIC ENGINEERING

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|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Module name | Biomagnetic Engineering | |
| Module level | Undergraduate | |
| Code | EB234505 | |
| Course (if applicable) | Biomagnetic Engineering | |
| Semester | Fifth Semester (Genap) | |
| Person responsible for the module | Rezki El Arif, ST., MT., Ph.D | |
| Lecturer | Rezki El Arif, ST., MT., Ph.D | |
| Language | Bahasa Indonesia and English | |
| Relation to curriculum | Undergraduate degree program, mandatory , 5 th semester. | |
| Type of teaching, contact hours | Lectures, <60 students | |
| Workload | <ol style="list-style-type: none"> 1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 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 | EB234404 – Engineering Mathematics | |
| Learning outcomes and their corresponding PLOs | <p>Course Learning Outcome (CLO) after completing this module,</p> <p>CLO 1: Students are able to understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited</p> <p>CLO 2: Students are able to understand the theory and basic equations concerning bioelectromagnetic phenomena</p> <p>CLO 3: Students are able to understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering.</p> | |
| 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 | <ul style="list-style-type: none"> • In-class exercises • Assignment 1, 2, 3, 4, 5 | |

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| requirements and forms of examination | <ul style="list-style-type: none"> • Mid-term examination • Final examination |
| Media employed | LCD, whiteboard, websites (myITS Classroom), zoom. |
| Reading list | <p>Main :</p> <ol style="list-style-type: none"> 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 2. Changzhi Li, Mohammad Tofighi, Dominique Schreurs, Tzyy-Sheng Jason Horng,"Principles and Applications of RF/Microwave in Healthcare and Biosensing", Elsevier Science (Verlag), 2016. Available online di: https://www.lehmanns.de/shop/medizin-pharmazie/37334402-9780128092187-principles-and-applications-of-rf-microwave-in-healthcare-and-biosensing |

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 <i>Biomagnetic Engineering</i> | | EB234505 | Ilmu Dasar Teknik <i>Basic Engineering</i> | T=3 | P=0 | V | 27 Oktober 2022 |
| OTORISASI / PENGESAHAN AUTHORIZATION / ENDORSEMENT | | Dosen Pengembang RPS Developer Lecturer of Semester Learning Plan | | Koordinator RMK Course Cluster Coordinator | | Ka DEPARTEMEN Head of Department | |
| | | (Rezki El Arif, S. T., M.T., Ph.D.) | | (Dr. Norma Hermawan, S.T., M.Sc.) | | (Dr. Achmad Arifin, S.T., M.Eng.) | |
| Capaian Pembelajaran | | CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to The Course</i> | | | | | |
| Learning Outcomes | | CPL-01 LLO-01 | Mampu menerapkan Ilmu Pengetahuan Alam dan Matematika pada bidang Teknik Biomedika <i>Able to apply Natural Sciences and Mathematics in the field of Biomedical Engineering</i> | | | | |
| | | 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 <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 LLO-06 | 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> | | | | |

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| | <p>CPL-08</p> <p>LLO-08</p> | <p>Mampu bekerja dalam tim lintas disiplin dan budaya serta bertanggung jawab kepada masyarakat dan mematuhi hukum dan etika profesi dalam menyelesaikan masalah Teknik Biomedika</p> <p><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></p> |
| <p>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO) - If CLO as description capability of each Learning Stage in the course, then CLO = LLO</p> | | |
| | <p>CP MK 1 CLO 1</p> | <p>Mahasiswa memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis.</p> <p><i>Students are able to understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited</i></p> |
| | <p>CP MK 2 CLO 2</p> | <p>Mahasiswa memahami teori dan persamaan-persamaan dasar yang menyangkut fenomena-fenomena bioelektromagnetik.</p> <p><i>Students are able to understand the theory and basic equations concerning bioelectromagnetic phenomena</i></p> |
| | <p>CP MK 3 CLO 3</p> | <p>Mahasiswa memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik.</p> <p><i>Students are able to understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering.</i></p> |

| <p>Peta CPL – CP MK</p> <p><i>Map of PLO - CLO</i></p> | <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </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> | | √ | | | | | | √ | | | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------------------------------------|---|--|--|--|--|--|--|--|--|--|--|--|---------------------------------------------|--|--|--|--|--|---|--|--|--|--|--|--|---------------------------------------------|--|---|--|--|--|--|--|---|--|--|--|--|
| | 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> | | √ | | | | | | √ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Diskripsi Singkat MK</p> <p><i>Short Description of Course</i></p> | <p>Cakupan bahasan tentang dasar-dasar teknik biomagnetika yang melatarbelakangi fenomena-fenomena biomedis pada tubuh makhluk hidup, dan aplikasinya pada bidang teknik biomedika</p> <p><i>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</i></p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Bahan Kajian:</p> <p>Materi pembelajaran</p> <p>Course Materials:</p> | <ol style="list-style-type: none"> 1. Dasar medan listrik dan medan magnet /<i>Basic electrical field and magnetic field</i> 2. Pengenalan Biomagnetisme /<i>Introduction to Biomagnetism</i> 3. Pengukuran Biomagnetisme / <i>Biomagnetism Measurement</i> 4. Prinsip Magnetic Resonance Imaging / <i>Magnetic Resonance Imaging Principle</i> 5. Impedansi Biomagnetik / <i>Biomagnetic Impedance</i> 6. Prospek MRI menggunakan Impedance dan arus listrik /<i>MRI prospect with using impedance and electrical current</i> 7. Efek medan elektromagnetik pada jaringan biologis /<i>Electromagnetic field effect on biological tissue</i> 8. Aspek Keselamatan pada medan Elektromagnetik /<i>Safety aspect on electromagnetic field</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Pustaka <i>References</i> | Utama / Main: | | | | | | |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------|
| | <ol style="list-style-type: none"> 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 2. Changzhi Li, Mohammad Tofighi, Dominique Schreurs, Tzyy-Sheng Jason Horng, "Principles and Applications of RF/Microwave in Healthcare and Biosensing", Elsevier Science (Verlag), 2016. Available online di: https://www.lehmanns.de/shop/medizin-pharmazie/37334402-9780128092187-principles-and-applications-of-rf-microwave-in-healthcare-and-biosensing | | | | | | |
| | Pendukung / Supporting: | | | | | | |
| Dosen Pengampu <i>Lecturers</i> | Eko Setijadi, ST., MT., Ph.D | | | | | | |
| Matakuliah syarat <i>Prerequisite</i> | EB234303 - Matematika Teknik EB234303 – <i>Engineering Mathematics</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> | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |


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| <p>1-3</p> | <p>Mahasiswa memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis.</p> <p><i>Students understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited</i></p> | <ul style="list-style-type: none"> • Memahami pengetahuan dasar anatomi dan fisiologi jaringan tubuh yang dapat tereksitasi secara elektromagnetis . • <i>Understand the basic of anatomy and physiology of body tissur that can be electromagnetically excited</i> | <p>Non-tes : Tugas Tertulis 1: Mengerjakan soal-soal teori dan perhitungan terkait medan listrik, medan magnet</p> <p>Tugas Tertulis 2: Resume mengenai Biomagnetisme</p> <p>Non-test : Written Assignment 1: Working on theory and calculation questions regarding electrical field, magnetic field</p> <p>Written Assignment 2: Resume regarding Biomagnetism</p> | <ul style="list-style-type: none"> • Kuliah dan brainstorming, tanya jawab. [TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • <i>Presentation and brainstorming, ask and answer. [FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]</i> | <ul style="list-style-type: none"> • Chatting dan diskusi dalam forum platform ITS. • <i>Chat and discussion in ITS platform forum.</i> | <ul style="list-style-type: none"> • Dasar medan listrik dan medan magnet • Pengenalan Biomagnetisme • <i>Basic electrical field and magnetic field</i> • <i>Introduction to Biomagnetism</i> | <p>Tugas 1: 5</p> <p>Tugas 2: 5</p> <p>Assignme nt 1: 5</p> <p>Assignme nt 2: 5</p> |
| <p>4-7</p> | <p>Mahasiswa memahami teori dan persamaan-persamaan dasar yang menyangkut fenomena-fenomena bioelektromagnetik.</p> <p><i>Students understand the theory and basic equations</i></p> | <ul style="list-style-type: none"> • Memahami teori dan persamaan-persamaan dasar yang menyangkut fenomena-fenomena | <p>Non-tes : Tugas Tertulis 3: Mengerjakan soal-soal teori, aplikasi dan perhitungan</p> | <ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, latihan soal, tugas. [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] | | <ul style="list-style-type: none"> • Pengukuran Biomagnetisme • <i>Biomagnetism Measurement</i> | <p>Tugas 3: 5</p> |

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| | concerning bioelectromagnetic phenomena | bioelektromagnetik <ul style="list-style-type: none"> Understand the theory and basic equations concerning bioelectromagnetic phenomena | biomagnetisme pada tubuh manusia Non-test : Written Assignment 3: Working on biomagnetism in the human body theory, application, and calculation questions | <ul style="list-style-type: none"> Presentation, discussion, ask and answer, exercise, assignment [FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"] | | | 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. <i>Students understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering</i> | <ul style="list-style-type: none"> Memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik Understand the theory behind the | Non-tes : Tugas Tertulis 4: Mengerjakan soal-soal teori, aplikasi dan perhitungan yang mendasari instrument MRI, impedansi biomagnetik, serta prospek penggunaan di masa depan Tugas Presentasi : Presentasi secara individu | <ul style="list-style-type: none"> Kuliah, diskusi, tanya jawab, latihan soal, tugas [TM : 2 x 50"] [BM : 2 x 50"] [PT : 2 x 50"] Presentation, discussion, ask and answer, exercise, assignment [FF : 4 x 50"] | | <ul style="list-style-type: none"> Prinsip Magnetic Resonance Imaging Impedansi Biomagnetik Prospek MRI menggunakan Impedance dan arus listrik Efek medan elektromagnetik pada jaringan biologis | Tugas 4: 5 Tugas 5: 20 |

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| | | <p><i>bioelectromagnetic science applications on measurement in biomedical engineering</i></p> | <p>mengenai efek medan elektromagnetik pada jaringan tubuh dan keselamatan pada medan elektromagnetik</p> <p>Non-test : Written Assignment 4: <i>Working on theory, application, and calculation which underlie MRI instrument, biomagnetic impedance and future use prospect</i></p> <p>Presentation Assignment : <i>Individual presentation regarding electromagnetic field effect in the body tissue and safety on electromagnetic field</i></p> | <p>[SA : 4 x 60"] [SS : 4 x 60"]</p> | | <ul style="list-style-type: none"> • Aspek Keselamatan pada medan Elektromagnetik • <i>Magnetic Resonance Imaging Principal</i> • <i>Biomagnetic Impedance</i> • <i>MRI prospect using Impedance and electrical current</i> • <i>Electromagnetic field effect on biological tissue</i> • <i>Safety Aspect on Electromagnetic field</i> | <p>Assignme nt 4: 5</p> <p>Assignme nt 5: 20</p> |
| 15-16 | EVALUASI TENGAH 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 : Biomagnetic Engineering | | RA&E |
| | | | Write Doc Code |
| Kode/code: EB234505 | Bobot sks/credits (T/P): 3/0 | Rumpun MK: Ilmu Dasar Teknik Course Cluster: Basic Engineering | Smt: V |
| OTORISASI AUTHORIZATION | Penyusun RA & E Compiler A&EP Nada Fitriyatul H, S.T, M.T | Koordinator RMK Course Cluster Coordinator Dr. Norma Hermawan, 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: <i>Students understand the basic of anatomy and physiology of body tissue that can be electromagnetically excited</i> | 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: <i>Working on theory and calculation questions regarding electrical field, magnetic field</i> Task 2: <i>Resume regarding Biomagnetism</i> Test: <i>1 Question on Mid-semester Exam</i> | 20 |
| 4-7 | Sub CP-MK 2: Mahasiswa memahami teori dan persamaan-persamaan dasar yang menyangkut fenomena-fenomena bioelektromagnetik. | Non-tes : Tugas 3: Mengerjakan soal-soal teori, aplikasi dan perhitungan biomagnetisme pada tubuh manusia Tes: 1 Soal pada ETS Non-test : | 25 |

| Mg ke/ Week (1) | Sub CP-MK / Lesson Learning Outcomes (LLO) (2) | Bentuk Asesmen (Penilaian) Form of Assessment (3) | Bobot / Load (%) (4) |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| | <p>LLO 2: <i>Students understand the theory and basic equations concerning bioelectromagnetic phenomena</i></p> | <p>Task 3: <i>Working on biomagnetism in the human body theory, application, and calculation questions</i></p> <p>Test: <i>1 Question on Mid-semester Exam</i></p> | |
| 8 | <p>Evaluasi Tengah Semester</p> <p>Mid Exam</p> | <p>Tes: Ujian Tulis/Ujian Daring</p> <p>Test: <i>Writing Exams / Online Exams</i></p> | 30 |
| 9-14 | <p>Sub CP-MK 3: Mahasiswa memahami teori yang melatarbelakangi aplikasi-aplikasi ilmu bioelektromagnetik pada pengukuran dalam teknik biomedik.</p> <p>LLO 3: <i>Students understand the theory behind the bioelectromagnetic science applications on measurement in biomedical engineering</i></p> | <p>Non-tes :</p> <p>Tugas 4: Mengerjakan soal-soal teori, aplikasi dan perhitungan yang mendasari instrument MRI, impedansi biomagnetik, serta prospek penggunaan di masa depan</p> <p>Tugas Demo dan Laporan: Presentasi secara individu mengenai efek medan elektromagnetik pada jaringan tubuh dan keselamatan pada medan elektromagnetik</p> <p>Tes: 2 Soal pada EAS</p> <p>Non-test :</p> <p>Task 4: <i>Working on theory, application, and calculation which underlie MRI instrument, biomagnetic impedance and future use prospect</i></p> <p>Demo Assignment and Reports: <i>Individual presentation regarding electromagnetic field effect in the body tissue and safety on electromagnetic</i></p> <p>Test: <i>2 Question on Final Exam</i></p> | 55 |
| 15-16 | <p>Evaluasi Akhir</p> <p>Final Exam</p> | <p>Tes: Ujian Tulis/Ujian Daring</p> <p>Test: <i>Writing Exams / Online Exams</i></p> | 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-01 / <i>PLO-01</i> | CPMK 1 / <i>CLO 1</i> | Week- 1-3 | Task 1 | 10 |
| | | Week- 1-3 | Task 2 | 10 |
| | | Week- 8 | 1 Question on Mid Exam | 15 |
| CPL-02 / <i>PLO-02</i> | CPMK 3 / <i>CLO 3</i> | Week- 9-14 | Task 4 | 13.75 |
| | | Week- 9-14 | Demo Assignment | 13.75 |
| | | Week- 16 | 2 Question on Final Exam | 15 |
| CPL-06 / <i>PLO-06</i> | CPMK 2 / <i>CLO 2</i> | Week- 4-7 | Task 3 | 25 |
| | | Week- 8 | 1 Question on Mid Exam | 15 |
| CPL-08 / <i>PLO-08</i> | CPMK 3 / <i>CLO 3</i> | Week- 9-14 | Task 4 | 13.75 |
| | | Week- 9-14 | Demo Assignment | 13.75 |
| | | CPMK 6 / <i>CLO 6</i> | Week- 16 | 2 Question on Final Exam |
| | | | | Σ = 100% |

| No | Form of Assessment | PLO-01 | PLO-02 | PLO-03 | PLO-04 | PLO-05 | PLO-06 | PLO-07 | PLO-08 | PLO-09 | PLO-10 | PLO-11 | PLO-12 | Total |
|----|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 1 | 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 |
| 7 | Final 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 |
|----|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| | Total | 0.35 | 0.425 | | | | 0.4 | | 0.425 | | | | | 1 |

