



MODULE HANDBOOK MULTIMODAL BIOMEDICAL IMAGE ANALYSIS



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

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

ENDORSEMENT PAGE



MODULE HANDBOOK

Multimodal Biomedical Image Analysis

DEPARTMENT OF BIOMEDICAL ENGINEERING

INSTITUT TEKNOLOGI SEPULUH NOPEMBER
Number : 6870/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. Tri Arief Sardjono, S.T., M.T.	Dosen <i>Lecturer</i>		November 18, 2022
Pemeriksa dan Pengendalian <i>Review and Control</i>	Nada F. H., S.T. 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

MULTIMODAL BIOMEDICAL IMAGE ANALYSIS

Module name	Multimodal Biomedical Image Analysis	
Module level	Undergraduate	
Code	EB234909	
Course (if applicable)	Multimodal Biomedical Image Analysis	
Semester	Specialization	
Person responsible for the module	Nada Fitriyatul Hikmah, S.T., M.T.	
Lecturer	Nada Fitriyatul Hikmah, S.T., M.T. Dr. Tri Arief Sardjono, S.T., M.T.	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, specialization .	
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 60 = 160 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	-	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO 1: Students understand the concepts of multimodal imaging. CLO 2: Students understand the image processing algorithm for multimodal imaging. CLO 3: Students able to identify problems or limitation of imaging technique. CLO 4: Students able to analyze and determine the imaging techniques that are required for multimodal imaging based on the problems in medical field.	PLO-02 PLO-05 PLO-09 PLO-06
Content	This course studies about the problems and limitation that are contained in the imaging techniques to provide aided diagnosis and	

	treatment that is desired by medical personnel where one of the solutions is integrating two or more of medical imaging
Study and examination requirements and forms of examination	<ul style="list-style-type: none"> • In-class exercises • Written Assignment 1 • Presentation 1, 2, 3, 4, 5 • Mid-term examination • Final examination
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.
Reading list	

Multimodal Biomedical Data Analysis

(Image + Non Image - Data Biopotential, evoked response, pressure)

1. Konsep Multimodal Biomedical Data Analysis

- (2x) - single sensor ^{single image} multi image
- multi sensor single image

(1x) 2. Multimodal signal analysis

- (2x) 3. 3D image extraction
- (2x) 4. Paper review
- (1x) 5. Spatial transformation Signal
Coordinate
modify by aspect ratio


(2x) 6. Registration

(1x) 7. Performance measurement for MBDA

(1x) 8. Reconstruction

(1x) 9. Visualization

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
<i>Multimodal Biomedical Image Analysis</i>		EB234909	<i>Teknik Biomedik Biomedical Engineering</i>	T=3	P=0	Peminatan Specialization	Oct 23, 2020
OTORISASI / PENGESAHAN AUTHORIZATION / ENDORSEMENT		Dosen Pengembang RPS Developer Lecturer of Semester Learning Plan		Koordinator RMK Course Cluster Coordinator		Ka DEPARTEMEN Head of Department	
		(Nada Fitriyatul Hikmah, S.T, M.T)		(Dr. Norma Hermawan, S.T., M.Sc.)		(Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran		CPL-PRODI yang dibebankan pada MK PLO Program Charged to The Course					
Learning Outcomes		CPL-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.				
		PLO-02	<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-05	Mampu mendesain komponen, sistem, dan proses dalam bidang Teknik Biomedika yang sistematis, logis, dan realistis sesuai dengan spesifikasi yang ditentukan dengan mempertimbangkan aspek keselamatan, sosial, budaya, lingkungan, dan ekonomi dengan mengenal/memanfaatkan sumber daya lokal dan nasional dengan wawasan global.				

PLO-05	Able to design components, systems, and processes in the field of Biomedical Engineering that are systematic, logical, and realistic appropriate with specified specifications by considering aspects of safety, social, cultural, environmental, and economic by recognizing / utilizing local and national resources with global insight.
CPL-06 PLO-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-09 PLO-09	Mampu mengetahui/mengikuti perkembangan terkini dibidang ilmu pengetahuan dan teknologi serta menyikapinya secara obyektif dengan mengedepankan nilai-nilai kebenaran universal. Able to know / follow the latest developments in the field of science and technology and to react objectively by promoting the values of universal truth.
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 konsep <i>multimodal imaging</i> . <i>Students understand the concepts of multimodal imaging.</i>
CP MK 2 CLO 2	Mahasiswa memahami algoritma pengolahan citra untuk <i>multimodal imaging</i> . <i>Students understand the image processing algorithm for multimodal imaging.</i>
CP MK 3 CLO 3	Mahasiswa mampu mengidentifikasi masalah atau limitasi dari masing-masing teknik pencitraan. <i>Students able to identify problems or limitation of imaging technique.</i>
CP MK 4 CLO 4	Mahasiswa mampu menganalisa dan menentukan teknik-teknik pencitraan yang dibutuhkan untuk <i>multimodal imaging</i> berdasarkan permasalahan dalam bidang kedokteran. <i>Students able to analyze and determine the imaging techniques that are required for multimodal imaging based on the problems in medical field.</i>

Peta CPL – CP MK Map of PLO - CLO	<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> <tr> <td>CPMK 4 / SUB CPMK 4 <i>CLO 4 / LLO 4</i></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>√</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </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>									√				CPMK 4 / SUB CPMK 4 <i>CLO 4 / LLO 4</i>						√						
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Diskripsi Singkat MK Short Description of Course	<p>Mata kuliah ini mempelajari tentang permasalahan dan limitasi yang terdapat pada teknik pencitraan untuk memberikan bantuan diagnosa dan perawatan yang diinginkan oleh tenaga medika dimana salah satu solusinya adalah mengintegrasikan dua atau lebih teknik pencitraan medika.</p> <p><i>This course studies about the problems and limitation that are contained in the imaging techniques to provide aided diagnosis and treatment that is desired by medical personnel where one of the solutions is integrating two or more of medical imaging.</i></p>																																																																	
Bahan Kajian: Materi pembelajaran Course Materials:	<ol style="list-style-type: none"> 1. Konsep <i>multimodal imaging / Multimodal imaging concepts</i> 2. Aplikasi <i>Tracking system</i> pada bidang kedokteran / <i>Tracking system application in medical field</i> 3. <i>Multimodal Image Registration</i> 4. Teknik pencitraan yang dapat diintegrasikan dengan <i>USG / Imaging techniques that can be integrated with USG</i> 5. Teknik pencitraan yang dapat diintegrasikan dengan <i>CT Scan / Imaging techniques that can be integrated with CT Scan</i> 6. Teknik pencitraan yang dapat diintegrasikan dengan <i>MRI / Imaging techniques that can be integrated with MRI</i> 																																																																	
Pustaka References	<table border="1"> <tr> <td>Utama / Main:</td> </tr> <tr> <td> </td> </tr> <tr> <td>Pendukung / Supporting:</td> </tr> </table>	Utama / Main:		Pendukung / Supporting:																																																														
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Dosen Pengampu Lecturers	Nada Fitriyatul Hikmah, Tri Arief Sardjono						
Matakuliah syarat Prerequisite	-						
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] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran <i>[Pustaka] / Learning Material [Reference]</i>	Bobot Penilaian / <i>Assess- ment 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	Mahasiswa memahami konsep <i>multimodal imaging</i> . <i>Students understand the concepts of multimodal imaging.</i>	<ul style="list-style-type: none"> Mampu menjelaskan limitasi dari teknik pencitraan medika yang tersedia dan konsep <i>multimodal imaging</i> yang dapat diaplikasikan guna mengatasi limitasi 	Non-tes : Tugas 1: Menjelaskan konsep <i>multimodal imaging</i> berdasarkan situasi yang ditentukan. (Tugas Tertulis)	<ul style="list-style-type: none"> Kuliah dan diskusi. [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 50"] <i>Lecturers and discussions.</i> [FF : 3 x 50"] [SA : 3 x 60"] 	<ul style="list-style-type: none"> Belajar mandiri melalui Share ITS dan myITSClassroom. <i>Self learning through Share ITS and myITSClassroom.</i> 	<ul style="list-style-type: none"> Konsep dasar multimodal imaging [Link materi di MyITSClassroom] <i>The basic concept of multimodal imaging</i> 	5

		<p>tersebut secara umum.</p> <ul style="list-style-type: none"> • <i>Able to explain the limitations of the available medical imaging techniques and multimodal imaging concepts that can be applied to overcome these limitations in general.</i> 	<p>Non-test : Task 1: <i>Describe the concept of multimodal imaging based on a defined situation.</i> <i>(Written Assignments)</i></p>	<p><i>[SS : 3 x 50"]</i></p>			
2	<p>Mahasiswa memahami aplikasi <i>tracking system</i> pada bidang kedokteran.</p> <p><i>Students understand the tracking system application in the medical field.</i></p>	<ul style="list-style-type: none"> • Mampu menjelaskan keutamaan penggunaan <i>tracking system</i> pada bidang kedokteran. • <i>Able to explain the virtue of the use of tracking system in the medical field.</i> 	<p>Non-tes : Presentation 1: Menjelaskan aplikasi <i>tracking system</i> yang telah berhasil digunakan pada bidang kedokteran berdasarkan makalah jurnal atau konferen yang tersedia.</p> <p>Non-test : Presentation 1: <i>Describe a tracking system application that has been</i></p>	<ul style="list-style-type: none"> • Kuliah dan diskusi. <i>[TM : 3 x 50"]</i> <i>[BM : 3 x 60"]</i> <i>[PT : 3 x 50"]</i> • <i>Lecturers and discussions.</i> <i>[FF : 3 x 50"]</i> <i>[SA : 3 x 60"]</i> <i>[SS : 3 x 50"]</i> 		<ul style="list-style-type: none"> • Konsep <i>Tracking System</i> • Aplikasi <i>Tracking System</i> yang telah digunakan pada bidang kedokteran • <i>Tracking system concept</i> • <i>Tracking system applications that have been used in the medical field</i> 	10

			<i>successfully used in the medical field based on available journal or conference papers.</i>				
3	<p>Mahasiswa memahami teknik pengolahan citra yang dapat digunakan pada multimodal imaging.</p> <p><i>Students understand image processing techniques that can be used in multimodal imaging.</i></p>	<ul style="list-style-type: none"> • Mampu menjelaskan teknik-teknik pengolahan citra yang digunakan pada <i>multimodal imaging</i>. • <i>Able to explain image processing techniques used in multimodal imaging.</i> 	<p>Non-tes : Presentasi 2: Menjelaskan teknik <i>image registration</i> yang dapat digunakan untuk multimodal imaging berdasarkan makalah jurnal atau konferen yang tersedia.</p> <p>Non-test : Presentation 2: Describe image registration that can be used for multimodal imaging based on available journal or conference papers.</p>	<ul style="list-style-type: none"> • Kuliah dan diskusi. [TM : 3 x 50"] [BM : 3 x 60"] [PT : 3 x 50"] • <i>Lecturers and discussions.</i> [FF : 3 x 50"] [SA : 3 x 60"] [SS : 3 x 50"] 		<ul style="list-style-type: none"> • <i>Multimodal Image Registration</i> 	10
4 – 7	<p>Mahasiswa memahami teknik multimodal imaging dengan menggunakan pencitraan</p>	<ul style="list-style-type: none"> • Mampu menjelaskan limitasi pada 	<p>Non-tes : Presentasi 3:</p>	<ul style="list-style-type: none"> • Kuliah dan diskusi. 		<ul style="list-style-type: none"> • USG dan CT Multimodal Imaging 	15


	<p>ultrasonik sebagai salah satu metode.</p> <p><i>Students understand multimodal imaging techniques using ultrasonic imaging as a method.</i></p>	<p>pencitraan ultrasonik yang membutuhkan multimodal imaging</p> <ul style="list-style-type: none"> • Mampu menjelaskan teknik multimodal imaging yang dapat dilakukan dengan pencitraan ultrasonik • <i>Able to explain limitations to ultrasonic imaging which requires multimodal imaging.</i> • <i>Able to explain multimodal imaging techniques that can be performed with ultrasonic imaging.</i> 	<p>Menjelaskan multimodal imaging yang dapat dilakukan dengan pencitraan ultrasonik berdasarkan makalah jurnal atau konferen yang tersedia.</p> <p>Non-test : Presentation 3: <i>Describe multimodal imaging that can be performed with ultrasonic imaging based on available journal or conference papaers.</i></p>	<p>[TM : 3 x 3 x 50"] [BM : 3 x 3 x 60"] [PT : 3 x 3 x 50"]</p> <ul style="list-style-type: none"> • <i>Lecturers and discussions.</i> <i>[FF : 3 x 3 x 50"]</i> <i>[SA : 3 x 3 x 60"]</i> <i>[SS : 3 x 3 x 50"]</i> 		<ul style="list-style-type: none"> • <i>USG dan MRI Multimodal Imaging</i> • <i>USG dan ECG Multimodal Imaging</i> • <i>USG dan EMG Multimodal Imaging</i> • <i>Multimodal imaging USG and CT</i> • <i>Multimodal imaging USG and MRI</i> • <i>Multimodal imaging USG and ECG</i> • <i>Multimodal imaging USG and EMG</i> 	
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						15

<p>9 – 13</p>	<p>Mahasiswa memahami teknik multimodal imaging dengan menggunakan pencitraan CT Scan sebagai salah satu metode.</p> <p><i>Students understand multimodal imaging techniques using CT scan imaging as a method.</i></p>	<ul style="list-style-type: none"> • Mampu menjelaskan limitasi pada pencitraan CT Scan yang membutuhkan multimodal imaging • Mampu menjelaskan teknik multimodal imaging yang dapat dilakukan dengan pencitraan CT Scan • <i>Able to explain limitations to CT Scan imaging which requires multimodal imaging.</i> • <i>Able to explain multimodal imaging techniques that can be performed with CT Scan imaging.</i> 	<p>Non-tes : Presentation 4: Menjelaskan multimodal imaging yang dapat dilakukan dengan pencitraan CT Scan berdasarkan makalah jurnal atau konferen yang tersedia.</p> <p>Non-test : Presentation 4: <i>Describe multimodal imaging that can be performed with CT Scan imaging based on available journal or conference papers.</i></p>	<ul style="list-style-type: none"> • Kuliah dan diskusi. [TM : 6 x 3 x 50"] [BM : 6 x 3 x 60"] [PT : 6 x 3 x 50"] • <i>Lecturers and discussions.</i> [FF : 6 x 3 x 50"] [SA : 6 x 3 x 60"] [SS : 6 x 3 x 50"] 		<ul style="list-style-type: none"> • <i>CT dan MRI Multimodal Imaging.</i> • <i>PET and CT Scan Multimodal Imaging</i> • <i>Multimodal CT Imaging</i> 	<p>15</p>
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<p>14</p>	<p>Mahasiswa memahami teknik multimodal imaging dengan menggunakan pencitraan MRI sebagai salah satu metode.</p> <p><i>Students understand multimodal imaging techniques using MRI imaging as a method.</i></p>	<ul style="list-style-type: none"> • Mampu menjelaskan limitasi pada pencitraan MRI yang membutuhkan multimodal imaging • Mampu menjelaskan teknik multimodal imaging yang dapat dilakukan dengan pencitraan MRI. • <i>Able to explain limitations to MRI imaging which requires multimodal imaging.</i> • <i>Able to explain multimodal imaging techniques that can be performed with MRI imaging.</i> 	<p>Non tes: Presentasi 5: Menjelaskan multimodal imaging yang dapat dilakukan dengan pencitraan MRI/fMRI berdasarkan makalah jurnal atau konferen yang tersedia</p> <p>Non-test : Presentation 5: <i>Describe multimodal imaging that can be performed with MRI/fMRI imaging based on available journal or conference papaers.</i></p>	<ul style="list-style-type: none"> • Kuliah dan diskusi. [TM : 2 x 3 x 50"] [BM : 2 x 3 x 60"] [PT : 2 x 3 x 50"] • <i>Lecturers and discussions.</i> [FF : 2 x 3 x 50"] [SA : 2 x 3 x 60"] [SS : 2 x 3 x 50"] 	<ul style="list-style-type: none"> • <i>PET and MRI Multimodal Imaging.</i> • <i>EEG and fMRI Multimodal Imaging</i> 	<p>15</p>
<p>15-16</p>	<p>EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM</p>					<p>15</p>

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 : Multimodal Biomedical Image Analysis		RA&E
			Write Doc Code
Kode/code: EB234909	Bobot sks/credits (T/P): 3/0	Rumpun MK: Teknik Biomedik Course Cluster: <i>Biomedical Engineering</i>	Smt: Peminatan <i>Specialization</i>
OTORISASI AUTHORIZATION	Penyusun RA & E Compiler A&EP Nada Fitriyatul H, S.T, M.T	Koordinator RMK Course Cluster Coordinator Muhammad Hilman Fatoni, S.T., M.T.	Ka DEP Head of DEP Dr. Achmad Arifin, S.T., M.Eng.

Mg ke/ Week (1)	Sub CP-MK / <i>Lesson Learning</i> <i>Outcomes (LLO)</i> (2)	Bentuk Asesmen (Penilaian) <i>Form of Assessment</i> (3)	Bobot / <i>Load (%)</i> (4)
1	Sub CP-MK 1: Mahasiswa memahami konsep <i>multimodal imaging</i> . LLO 1: <i>Students understand the concepts of multimodal imaging.</i>	Non-tes : Tugas 1: Menjelaskan konsep multimodal imaging berdasarkan situasi yang ditentukan. (Tugas Tertulis) Tes: ETS Soal 1 (3% dari ETS 15%) Non-test : Task 1: <i>Describe the concept of multimodal imaging based on a defined situation.</i> (Written Assignments) Test: <i>Question 1 in Mid Exam (3% of Mid Exam 15%)</i>	5
2	Sub CP-MK 2: Mahasiswa memahami aplikasi <i>tracking system</i> pada bidang kedokteran. LLO 2: <i>Students understand the tracking system</i>	Non-tes : Presentasi 1: Menjelaskan aplikasi tracking system yang telah berhasil digunakan pada bidang kedokteran berdasarkan makalah jurnal atau konferen yang tersedia. Tes: ETS Soal 2 (4% dari ETS 15%) EAS Soal 1 (3% dari EAS 15%)	10

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	<i>application in the medical field.</i>	<p>Non-test : Presentation 1: <i>Describe a tracking system application that has been successfully used in the medical field based on available journal or conference papaers.</i></p> <p>Test: <i>Question 2 in Mid Exam (4% of Mid Exam 15%)</i> <i>Question 1 in Final Exam (3% of Final Exam 15%)</i></p>	
3	<p>Sub CP-MK 3: Mahasiswa memahami teknik pengolahan citra yang dapat digunakan pada multimodal imaging..</p> <p>LLO 3: <i>Students understand image processing techniques that can be used in multimodal imaging.</i></p>	<p>Non-tes : Presentasi 2: Menjelaskan teknik image registration yang dapat digunakan untuk multimodal imaging berdasarkan makalah jurnal atau konferen yang tersedia.</p> <p>Tes: ETS Soal 3 (4% dari ETS 15%) EAS Soal 2 (3% dari EAS 15%)</p> <p>Non-test : Presentation 2: <i>Describe image registration that can be used for multimodal imaging based on available journal or conference papaers.</i></p> <p>Test: <i>Question 3 in Mid Exam (4% of Mid Exam 15%)</i> <i>Question 2 in Final Exam (3% of Final Exam 15%)</i></p>	10
4 – 7	<p>Sub CP-MK 4: Mahasiswa memahami teknik multimodal imaging dengan menggunakan pencitraan ultrasonik sebagai salah satu metode.</p> <p>LLO 4: <i>Students understand multimodal imaging techniques using ultrasonic imaging as a method.</i></p>	<p>Non-tes : Presentasi 3: Menjelaskan multimodal imaging yang dapat dilakukan dengan pencitraan ultrasonik berdasarkan makalah jurnal atau konferen yang tersedia.</p> <p>Tes: ETS Soal 4 (4% dari ETS 15%) EAS Soal 3 (3% dari EAS 15%)</p> <p>Non-test : Presentation 3: <i>Describe multimodal imaging that can be performed with ultrasonic imaging based on available journal or conference papaers.</i></p> <p>Test: <i>Question 4 in Mid Exam (4% of Mid Exam 15%)</i> <i>Question 3 in Final Exam (3% of Final Exam 15%)</i></p>	15

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
8	Evaluasi Tengah Semester Mid Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Writing Exams / Online Exams</i>	15
9-13	Sub CP-MK 5: Mahasiswa memahami teknik multimodal imaging dengan menggunakan pencitraan CT Scan sebagai salah satu metode. LLO 5: <i>Students understand multimodal imaging techniques using CT scan imaging as a method.</i>	Non-tes : Presentasi 4: Menjelaskan multimodal imaging yang dapat dilakukan dengan pencitraan CT Scan berdasarkan makalah jurnal atau konferen yang tersedia. Tes: EAS Soal 4 (3% dari EAS 15%) Non-test : Presentation 4: <i>Describe multimodal imaging that can be performed with CT Scan imaging based on available journal or conference papaers.</i> Test: <i>Question 4 in Final Exam (3% of Final Exam 15%)</i>	15
14	Sub CP-MK 6: Mahasiswa memahami teknik multimodal imaging dengan menggunakan pencitraan MRI sebagai salah satu metode. LLO 6: <i>Students understand multimodal imaging techniques using MRI imaging as a method.</i>	Non tes: Presentasi 5: multimodal imaging yang dapat dilakukan dengan pencitraan MRI/fMRI berdasarkan makalah jurnal atau konferen yang tersedia Tes: EAS Soal 5 (3% dari EAS 15%) Non-test : Presentation 5: <i>Describe multimodal imaging that can be performed with MRI/fMRI imaging based on available journal or conference papaers.</i> Test: <i>Question 5 in Final Exam (3% of Final Exam 15%)</i>	15
15-16	Evaluasi Akhir Final Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Writing Exams / Online Exams</i>	15
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 / <i>PLO-02</i>	CPMK 1 / <i>CLO 1</i>	Week- 1	<i>Written Assignment 1</i>	5
		Week- 8	<i>Mid Exam Question 1</i>	3
CPL-05 / <i>PLO-05</i>	CPMK 2 / <i>CLO 2</i>	Week- 2	<i>Presentation 1</i>	10
		Week- 8	<i>Mid Exam Question 2</i>	4
		Week- 16	<i>Final Exam Question 1</i>	3
CPL-06 / <i>PLO-06</i>	CPMK 4 / <i>CLO 4</i>	Week- 3	<i>Presentation 2</i>	10
		Week- 8	<i>Mid Exam Question 3</i>	4
		Week- 16	<i>Final Exam Question 2</i>	3
CPL-09 / <i>PLO-09</i>	CPMK 3 / <i>CLO 3</i>	Week- 4-7	<i>Presentation 3</i>	15
		Week- 9-13	<i>Presentation 4</i>	15
		Week- 14	<i>Presentation 5</i>	15
		Week- 8	<i>Mid Exam Question 4</i>	4
		Week- 16	<i>Final Exam Question 3, 4, 5</i>	9
				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	<i>Written Assignment 1</i>		0.05											0.05
2	<i>Presentation 1</i>					0.1								0.1
3	<i>Presentation 2</i>						0.1							0.1

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
4	Presentation 3									0.15				0.15
5	Presentation 4									0.15				0.15
6	Presentation 5									0.15				0.15
7	Mid Exam		0.03			0.04	0.04			0.04				0.15
8	Final Exam					0.03	0.03			0.09				0.15
	Total		0.08			0.17	0.17			0.58				1

