

Module Handbook

Medical Robotics



Bachelor Degree Program Department of Biomedical Engineering

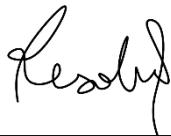
Faculty of Intelligent Electrical Technology and Informatics
Institut Teknologi Sepuluh Nopember



MODULE HANDBOOK
Medical Robotics
DEPARTMENT OF BIOMEDICAL ENGINEERING

INSTITUT TEKNOLOGI SEPULUH NOPEMBER
Number : 6867/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. Tri Arief Sardjono, S.T., M.T.	Dosen <i>Lecturer</i>		November 18, 2022
Pemeriksa dan Pengendalian <i>Review and Control</i>	Dr. Achmad Arifin, S.T., M.Eng.	Tim kurikulum <i>Curriculum team</i>		November 20, 2022
Persetujuan <i>Approval</i>	Ir. Josaphat Pramudijanto, M.Eng.	Koordinator RMK <i>Course Cluster Coordinator</i>		April 13, 2023
Penetapan <i>Determination</i>	Dr. Achmad Arifin, S.T., M.Eng.	Kepala Departemen <i>Head of Department</i>		April 17, 2023

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MODULE HANDBOOK

MEDICAL ROBOTIC

Module name	Medical Robotic	
Module level	Undergraduate	
Code	EB234905	
Course (if applicable)	Medical Robotic	
Semester	First Semester	
Lecturer	1. Fauzan Arrofiqi, S.T., M.T., Ph.D. 2. Eko Agus Suprayitno, S.Si., M.T.	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, specialization	
Type of teaching, contact hours	Lectures, <60 students Tuesdays, 11.00-12.50 (GMT+7)	
Workload	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 50 = 150 minutes per week. 3. Private learning : 2 x 60 = 120 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	Fundamentals of Microcontrollers and Microprocessors	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO 1: Students understand and are able to explain the basic concepts of robot design and robot application in the medical world CLO 2: Students understand and are able to explain the basic concepts of Minimally Invasive Surgery (MIS) CLO 3: Students understand and are able to explain the basic concepts of interventional radiology robots. CLO 4: Students know, understand and are able to explain the latest developments related to medical robotics	PLO-04 PLO-02 PLO-05 PLO-02
Content	This Medical Robotics course aims to provide an understanding of the basics of robot design and the use of robots in the medical field such as prosthetic robots, robots for medical surgery, Minimally Invasive	

	Surgery (MIS), and the latest developments in medical robotics technology. Students are expected to be able to implement this knowledge in the development of medical robotics technology
Study and examination requirements and forms of examination	• In-class exercises • Assignment 1, 2, 3,4,5,6,7 • Mid-term examination • Final examination
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.
Reading list	Main : 1. Cooper, Rory A. "An Introduction to Rehabilitation Engineering." CRC Press. 2. Bronzino, Joseph D. "The Biomedical Engineering Handbook," CRC Press. Supporting : 1. Mark L Latash, Neurophysiological basis of movement. Human Kinetics, USA, 1998. 2. Robert M Enoka, Neuromechanics of human movement, 3rd Ed. Human Kinetics, USA, 2002.

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>
Robotika Medika <i>Medical Robotic</i>	EB234905	Teknik Biomedik <i>Biomedical Engineering</i>	T=3	P=0	Peminatan <i>Specialization</i>	Nov 19, 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>	
	Eko Agus Suprayitno, S.Si., M.T.		(Ir. Josaphat Pramudijanto, M.Eng.)		(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	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				
	PLO-02	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				

		<i>learning activities others whose output is equivalent to the final assignment through logical, critical, systematic and innovative thinking.</i>
CPL-04 PLO-04		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-05 PLO-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. <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>
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 dan mampu menjelaskan tentang konsep dasar perancangan robot dan aplikasi robot dalam dunia medis <i>Students understand and are able to explain the basic concepts of robot design and robot application in the medical world</i>
CP MK 2 CLO 2		Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar <i>Minimally Invasive Surgery (MIS)</i> <i>Students understand and are able to explain the basic concepts of Minimally Invasive Surgery (MIS)</i>
CP MK 3 CLO 3		Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar interventional radiology robot <i>Students understand and are able to explain the basic concepts of interventional radiology robots</i>
CP MK 4 CLO 4		Mahasiswa mengetahui, memahami dan mampu menjelaskan tentang perkembangan terkini terkait robotika medika <i>Students know, understand and are able to explain the latest developments related to medical robotics</i>

Peta CPL – CP MK <i>Map of PLO - CLO</i>	<table><tr><th></th><th>CPL-0 1</th><th>CPL-0 2</th><th>CPL-0 3</th><th>CPL-0 4</th><th>CPL-0 5</th><th>CPL-0 6</th><th>CPL-0 7</th><th>CPL-0 8</th><th>CPL-0 9</th><th>CPL-1 0</th><th>CPL-1 1</th><th>CPL-1 2</th></tr><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></table>		CPL-0 1	CPL-0 2	CPL-0 3	CPL-0 4	CPL-0 5	CPL-0 6	CPL-0 7	CPL-0 8	CPL-0 9	CPL-1 0	CPL-1 1	CPL-1 2	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>		✓										
	CPL-0 1	CPL-0 2	CPL-0 3	CPL-0 4	CPL-0 5	CPL-0 6	CPL-0 7	CPL-0 8	CPL-0 9	CPL-1 0	CPL-1 1	CPL-1 2																																																						
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>		✓																																																																
Diskripsi Singkat MK <i>Short Description of Course</i>	Mata kuliah Robotika Medika ini bertujuan untuk memberikan pemahaman tentang dasar-dasar perancangan robot dan penggunaan robot dalam bidang medis seperti robot prostetik, robot untuk operasi medis, Minimally Invasive Surgery (MIS), dan perkembangan terkini dari teknologi robotika medika. Mahasiswa diharapkan mampu mengimplementasikan pengetahuan tersebut dalam pengembangan teknologi robotika medika <i>The Medical Robotics course aims to provide an understanding of the basics of robot design and the use of robots in the medical field such as prosthetic robots, robots for medical surgery, Minimally Invasive Surgery (MIS), and the latest developments in medical robotics technology. Students are expected to be able to implement this knowledge in the development of medical robotics technology</i>																																																																	
Bahan Kajian: Materi pembelajaran	1. Pengenalan robotika/ <i>Introduction to robotics</i> 2. Robotika prostetik/ <i>Prosthetic robotics</i> 3. <i>Minimally Invasive Surgery (MIS)</i> 4. <i>Telesurgery</i> 5. Topik terkini dalam robotika medika / <i>Current topics in medical robotics</i>																																																																	

Course Materials:	
Pustaka References	Utama / Main: Cooper, Rory A. "An Introduction to Rehabilitation Engineering." CRC Press. Bronzino, Joseph D. "The Biomedical Engineering Handbook," CRC Press. Pendukung / Supporting: 1. Mark L Latash, Neurophysiological basis of movement. Human Kinetics, USA, 1998. 2. Robert M Enoka, Neuromechanics of human movement, 3rd Ed. Human Kinetics, USA, 2002.
Dosen Pengampu Lecturers	Eko Agus Suprayitno, S.Si., M.T. Fauzan Arrofiqi, S.T., M.T., Ph.D.
Matakuliah syarat Prerequisite	Fundamentals of Microcontrollers and Microprocessors

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <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>	(7)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1-4	Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar perancangan robot dan aplikasi robot dalam dunia medis <i>Students understand and are able to explain the basic concepts of robot design and robot application in the medical world</i>	● Kelengkapan dan kerapian hasil resume ● Ketepatan waktu pengumpulan tugas. ● Kebenaran melaksanakan tugas. ● Keberhasilan menjelaskan tugas dengan baik ● Kelengkapan dan kerapian hasil resume ● Ketepatan waktu pengumpulan tugas.	Non-tes : Tugas 1: Mengerjakan soal perhitungan mengenai konsep dasar perancangan robot Tugas 2 : Mengenai aplikasi robot di dunia medis, hukum dan etika penggunaan robot di dunia medis	● Kuliah dan brainstorming , tanya jawab. 4[TM : 3 x 50"] 4[BM : 3 x 50"] 4[PT : 3 x 50"] ● <i>Presentation and brainstorming , ask and answer.</i> 4[FF : 3 x 50"] 4[SA : 3 x 50"] 4[SS : 3 x 50"]	● Chatting dan diskusi dalam forum platform ITS. ● <i>Chat and discussion in ITS platform forum.</i>	● Kontrak kuliah: - Motivasi belajar - Rencana pembelajaran - Aturan-aturan perkuliahan - Tujuan perkuliahan - Sistem penilaian, buku ajar/sumber pustaka ● Pengenalan pada robotika medika (aplikasi dan paradigma), konsep dasar perancangan kinematika dan	Tugas 1 Task 1 : 5 Tugas 2 Task 2 : 5

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <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>	(7)	(8)
		• Kebenaran melaksanakan tugas. • Keberhasilan menjelaskan tugas dengan baik • <i>Completeness and neatness of the resume results.</i> • <i>On time submission of assignments.</i> • <i>Tasks performed correctly</i> • <i>Success in completing assignments well.</i>	Non-test : Task 1 : <i>Work on calculation problems regarding the basic concepts of robot design</i> Task 2 : <i>Regarding the application of robots in the medical world,</i>			struktur robot (forward, inverse, remote center of motion), konsep dasar perancangan sistem kontrol robot, pemrograman robot, dasar operasi medis dan dasar radiologi intervensi (interventional radiology), hukum dan etika penggunaan robot dalam dunia medis [<i>Link materi di MyITSClassroom</i>]	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <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>	(7)	(8)
		• <i>Completeness and neatness of the resume results.</i> • <i>On time submission of assignments.</i> • <i>Tasks performed correctly</i> <i>Success in completing assignments well.</i>	<i>the law and ethics of using robots in the medical world</i>			• <i>Course contract:</i> - <i>Motivation to learn</i> - <i>Lesson plan</i> - <i>Lecture rules</i> - <i>Course objective</i> - <i>Assessment system, textbooks / library resources</i> • <i>Introduction to medical robotics (applications and paradigms), basic concepts of kinematics and robot structure design (forward,</i>	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment; [Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian /Assess ment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	
(1)	(2)	(3)	(4)				(8)
						reverse, remote center of motion), basic concepts of robot control system design, robot programming, medical operations and basic interventional radiology (interventional radiology), legal and ethical use of robots in the medical world.	
5-7	Mahasiswa memahami dan mampu menjelaskan		Non-tes : Tugas 3 :	• Kuliah, diskusi, tanya		• Minimally Invasive Surgery (MIS) :	Tugas 3 Task 3

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian /Assess ment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	tentang konsep dasar <i>Minimally Invasive Surgery (MIS)</i> <i>Students understand and are able to explain the basic concepts of Minimally Invasive Surgery (MIS)</i>	• Kebenaran pemahaman, jawaban dan analisa • Keberhasilan menjelaskan tugas • Ketepatan waktu pengumpulan tugas • Kebenaran pemahaman, jawaban dan analisa • Keberhasilan menjelaskan tugas • Ketepatan waktu pengumpulan tugas	Tugas tertulis mengenai konsep dasar MIS Tugas 4 : Tugas tertulis mengenai konsep disain robot untuk MIS, telesurgery Non-test : Task 3: <i>Written assignment on</i>	jawab, latihan soal, tugas 3x[TM: 3 x 50"] 3x[BM: 3 x 50"] 3x[PT: 3 x 50"] • <i>Presentation, discussion, ask and answer, exercise, assignment</i> 3x[FF: 3 x 50"] 3x[SA: 3 x 50"]		pengenalan tentang MIS, antarmuka manusia dan mesin, teleoperation dan telesurgery (operasi jarak jauh), cooperative manipulation, port placement (penentuan lokasi bukaan) untuk MIS, konsep disain robot untuk MIS, gambar dan video dalam MIS, augmented reality	: 5 Tugas 4 Task 4 : 5

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian /Assess ment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		• <i>Correct in understanding, answers and analysis</i> • <i>Able to explain the assignments</i> • <i>On time submission of assignments.</i> • <i>Correct in understanding, answers and analysis</i> • <i>Able to explain the assignments</i> • <i>On time submission of assignments.</i>	<i>basic MIS concepts</i> Task 4: <i>Written assignment on robot design concepts for MIS, telesurgery.</i>	3x[SS : 3 x 50"]		• <i>Minimally Invasive Surgery (MIS): introduction to MIS, human machine interfaces, teleoperation and telesurgery (remote operation), cooperative manipulation, port placement (determination of opening locations) for MIS, concept of robotic design for MIS, pictures and</i>	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian /Assess ment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class</i> (5)	Daring / <i>Online</i> (6)	(7)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
						<i>videos in MIS , augmented reality</i>	
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						20
9 - 11	Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar interventional radiology robot <i>Students understand and are able to explain the basic concepts of interventional radiology robots</i>	• Kebenaran pemahaman, jawaban dan analisa • Keberhasilan menjelaskan tugas • Ketepatan waktu pengumpulan tugas • Kebenaran pemahaman, jawaban dan analisa	Non-tes : Tugas 5 : Tugas tertulis mengenai konsep dasar radiologi dan radiologi intervensi Tugas 6 : Tugas tertulis mengenai konsep perancangan robot untuk	• Kuliah, diskusi, tanya jawab, latihan soal, tugas 3x[TM: 3 x 50"] 3x[BM: 3 x 50"] 3x[PT: 3 x 50"] • <i>Presentation, discussion, ask and answer,</i>		• Intervensi yang dipandu gambar : sumber-sumber gambar medika (MRI, ultrasound, sinar X, CT scan), kompatibilitas robot dengan sumber gambar medika, segmentasi dan pemodelan gambar, tracking device dan teknologi, frames and transformations,	Tugas 5 Task 5 : 5 Tugas 6 Task 6 : 5

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; <i>[Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran <i>[Pustaka] / Learning Material [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>	(7)	(8)
		- Keberhasilan menjelaskan tugas - Ketepatan waktu pengumpulan tugas <i>Correct in understanding, answers and analysis</i> <i>Able to explain the assignments</i> <i>On time submission of assignments.</i> <i>Correct in understanding, answers and analysis</i>	operasi medis berbasis gambar Non-test : Task 5: <i>Written assignment regarding the basic concepts of radiology and interventional radiology</i> Task 6: <i>Written assignment regarding the concept of designing robots</i>	<i>exercise, assignment</i> 3x[FF: 3 x 50"] 3x[SA: 3 x 50"] 3x[SS : 3 x 50"]		navigasi operasi medis, kalibrasi, registrasi rigid dan non-rigid, radiosurgery Image-guided interventions: medical image sources (MRI, ultrasound, X-ray, CT scan), compatibility of robots with medical image sources, image segmentation and modeling, tracking devices and technology, frames and transformations,	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <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>	(7)	
(1)	(2)	(3)	(4)				(8)
		- Able to explain the assignments - On time submission of assignments.	for image-based medical surgery			navigation of medical operations, calibration, rigid and non-rigid registration, radiosurgery	
12 -15	Mahasiswa mengetahui, memahami dan mampu menjelaskan tentang perkembangan terkini terkait robotika medika <i>Students know, understand and are able to explain the latest developments related to medical robotics</i>	- Kebenaran pemahaman, jawaban dan analisa - Keberhasilan menyelesaikan tugas - Ketepatan waktu pengumpulan tugas	Non tes: Tugas 7 : Tugas tertulis mengenai perkembangan terkini dari penggunaan teknologi robot dalam dunia medis Presentasi : Penentuan tema	- Kuliah dan brainstorming , tanya jawab. 4[TM: 3 x 50"] 4[BM : 3 x 50"] 4[PT : 3 x 50"] - Presentation and brainstorming		Topik terkini dalam robotika medika : Robotic Assistive Technologies, operasi medis pada jantung, sistem pencernaan, dan sistem urologis menggunakan robot operasi jarak jauh, operasi tulang dengan menggunakan	Tugas 7: Task 7: : 5 Presentasi Presentati -on : 25

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; <i>[Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran <i>[Pustaka] / Learning Material [Reference]</i>	Bobot Penilaian /Assess ment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class (5)</i>	Daring / <i>Online (6)</i>	(7)	(8)
		• <i>Correct in understanding, answers and analysis</i> • <i>Able to explain the assignments</i> • <i>On time submission of assignments.</i>	presentasi diberikan pada minggu ke – 9. Proses presentasi dilakukan pada minggu ke – 14-15 Non-test: Task 7: <i>Written assignment regarding the latest developments in the use of robotic technology in the medical world.</i> Presentation	, ask and answer. 4[FF : 3 x 50"] 4[SA : 3 x 50"] 4[SS : 3 x 50"]		robot, intervensi pada prostat dengan menggunakan robot, kateter robot untuk operasi jantung, dan lain-lain • <i>Current topics in medical robotics: Robotic Assisted Technology, medical surgery of the heart, digestive system and urological system using remote surgical robots, robotic</i>	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; <i>[Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran <i>[Pustaka] / Learning Material [Reference]</i>	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)
			<i>The theme for the presentation was given in the 9th week. The presentation process was carried out in the 14-15th week</i>			<i>bone surgery, robotic prostate intervention, robotic catheter for cardiac surgery, etc.</i>	
16	EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM						20

TM=Tatap Muka, **PT**=Penugasan Terstruktur, **BM**=Belajar Mandiri.

FF = Face to Face, **SA** = Structured Assignment, **SS** = Self Study.

II. Rencana Asesmen & Evaluasi (RAE) / *Assessment & Evaluation Plan*

	ASSESSMENT & EVALUATION PLAN BACHELOR DEGREE PROGRAM OF BIOMEDICAL ENGINEERING - FTEIC ITS Course : Medical Robotic		RA&E
			Write Doc Code Peminatan Specialization
Kode/code: EB234905	Bobot sks/credits (T/P): 3/0	Rumpun MK: Teknik Biomedik Course Cluster: Biomedical Engineering	Peminatan Specialization
OTORISASI AUTHORIZATION	Penyusun RA & E Compiler A&EP Eko Agus Suprayitno, S.Si., M.T.	Koordinator RMK Course Cluster Coordinator Ir. Josaphat Pramudijanto, M.Eng.	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	Sub CP-MK 1: Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar perancangan robot dan aplikasi robot dalam dunia medis LLO 1: Students understand and are able to explain the basic concepts of robot design and robot application in the medical world	Non-tes : Tugas 1: Mengerjakan soal perhitungan mengenai konsep dasar perancangan robot Tugas 2 : Mengenai aplikasi robot di dunia medis, hukum dan etika penggunaan robot di dunia medis Tes: Soal 1 dan 2 pada ETS Non-test : Task 1: Work on calculation problems regarding the basic concepts of robot design Task 2 : Regarding the application of robots in the medical world, the law and ethics of using robots in the medical world Test: Question 1 and 2 in Mid Exam	10
2	Sub CP-MK 2: Mahasiswa memahami dan mampu	Non-tes : Tugas 3 : Tugas tertulis mengenai konsep dasar MIS	10

	menjelaskan tentang konsep dasar <i>Minimally Invasive Surgery (MIS)</i> LLO 2: <i>Students understand and are able to explain the basic concepts of Minimally Invasive Surgery (MIS)</i>	Tugas 4 : Tugas tertulis mengenai konsep desain robot untuk MIS, telesurgery Tes: Soal 3,4 dan 5 pada ETS Soal 1 pada EAS Non-test : Task 3: <i>Written assignment on basic MIS concepts</i> Task 4: <i>Written assignment on robot design concepts for MIS, telesurgery.</i> Test: <i>Question 3,4 and 5 in Mid Exam</i> <i>Question 1 in Final Exam</i>	
8	Evaluasi Tengah Semester Mid Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Writing Exams / Online Exams</i>	20
9-11	Sub CP-MK 3: Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar interventional radiology robot LLO 3: <i>Students understand and are able to explain the basic concepts of interventional radiology robots</i>	Non-tes : Tugas 5 : Tugas tertulis mengenai konsep dasar radiologi dan radiologi intervensi Tugas 6 : Tugas tertulis mengenai konsep perancangan robot untuk operasi medis berbasis gambar Tes: Soal 2 dan 3 pada EAS Non-test : Task 5: <i>Written assignment regarding the basic concepts of radiology and interventional radiology</i> Task 6: <i>Written assignment regarding the concept of designing robots for image-based medical surgery</i> Test: <i>Question 2 and 3 in Final Exam</i>	10
12-15	Sub CP-MK 4: Mahasiswa mengetahui, memahami dan mampu menjelaskan tentang perkembangan	Non tes: Tugas 7 : Tugas tertulis mengenai perkembangan terkini dari penggunaan teknologi robot dalam dunia medis Presentasi : Penentuan tema presentasi diberikan pada minggu ke – 9. Proses presentasi dilakukan pada minggu ke – 14-15 Tes:	30

	terkini terkait robotika medika LLO 4: <i>Students know, understand and are able to explain the latest developments related to medical robotics</i>	Soal 4 dan 5 pada EAS Non-test: Task 7: <i>Written assignment regarding the latest developments in the use of robotic technology in the medical world.</i> Presentation <i>The theme for the presentation was given in the 9th week. The presentation process was carried out in the 14-15th week</i> Test: <i>Question 4 and 5 in Final Exam</i>	
16	Evaluasi Akhir Final Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Writing Exams / Online Exams</i>	20
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- 1-4	Task 1	5
		Week- 1-4	Task 2	5
		Week- 8	Mid Exam Question 1, 2	8
CPL-02 / <i>PLO-02</i>	CPMK 2 / <i>CLO 2</i>	Week- 5-7	Task 3	5
		Week- 5-7	Task 4	5
		Week 8	Mid Exam Question 3,4,5	12
		Week 16	Final Exam Question 1	4
	CPMK 3 / <i>CLO 3</i>	Week- 9-11	Task 5	5
		Week- 9-11	Task 6	5
		Week- 16	Final Exam Question 2,3	8
CPL-06 / <i>PLO-06</i>	CPMK 3 / <i>CLO 3</i>	Week- 12-15	Task 7	5
		Week- 12-15	Presentation	25
		Week- 16	Final Exam Question 4,5	8
				$\Sigma = 100\%$

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 (Task 1,2,3, dan 4) Assignment 1 (Task 1,2,3, and 4)		0.05		0.05									0.15
2	Tugas 2 (Task 5,6, dan 7) Assignment 2 (Task 5, 6, and 7)		0.05			0.05								0.2
3	Tugas Project Project Assignment		0.1		0.05	0.05								0.3
4	Evaluasi Tengah Semester Midterm exam		0.15		0.15									0.35

5	<i>Evaluasi Akhir Semester Final Exam</i>		0.15			0.15								0.35
	<i>Total</i>		0.5		0.25	0.25								1