



MODULE HANDBOOK MEDICAL ROBOTIC



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

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

ENDORSEMENT PAGE







MODULE HANDBOOK

Medical Robotics

DEPARTMENT OF BIOMEDICAL ENGINEERING

INSTITUT TEKNOLOGI SEPULUH NOPEMBER
Number : B/21384/IT2.IX.5.1.2/PP.03.00.00/2020

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 23, 2019
Pemeriksa dan Pengendalian <i>Review and Control</i>	Dr. Achmad Arifin, S.T., M.Eng.	Tim kurikulum <i>Curriculum team</i>		February 14, 2020
Persetujuan <i>Approval</i>	Ir. Josaphat Pramudijanto, M.Eng.	Koordinator RMK <i>Course Cluster Coordinator</i>		March 06, 2020
Penetapan <i>Determination</i>	Dr. Achmad Arifin, S.T., M.Eng.	Kepala Departemen <i>Head of Department</i>		March 13, 2020

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MODULE HANDBOOK

MEDICAL ROBOTIC

Module name	Medical Robotic	
Module level	Undergraduate	
Code	EB184905	
Course (if applicable)	Medical Robotic	
Semester	Specialization	
Person responsible for the module	Dr. Tri Arief Sardjono, S.T., M.T.	
Lecturer		
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	-	
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-01 PLO-02 PLO-02 PLO-06
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	<ul style="list-style-type: none"> ● 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	<p>Main :</p> <ol style="list-style-type: none"> 1. Cooper, Rory A. "An Introduction to Rehabilitation Engineering." CRC Press. 2. Bronzino, Joseph D. "The Biomedical Engineering Handbook," CRC Press. <p>Supporting :</p> <ol style="list-style-type: none"> 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) COURSE	KODE CODE	Rumpun MK Course Cluster	BOBOT (sks) Credits		SEMESTER	Tgl Penyusunan Compilation Date
Robotika Medika <i>Medical Robotic</i>	EB184905	Biocybernetics	T=3	P=0	Peminatan <i>Specialization</i>	Feb 27, 2020
OTORISASI / PENGESAHAN AUTHORIZATION / ENDORSEMENT	Dosen Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i> (Dr. Tri Arief Sardjono, S.T., M.T.)		Koordinator RMK <i>Course Cluster Coordinator</i> (Ir. Josaphat Pramudijanto, M.Eng.)		Ka DEPARTEMEN <i>Head of Department</i> (Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran	CPL-PRODI yang dibebankan pada MK PLO Program Charged to The Course					
Learning Outcomes	CPL-01 PLO-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-03 PLO-03	Mampu merancang dan melaksanakan eksperimen laboratorium dan/atau lapangan, menganalisa dan menginterpretasi data, serta menggunakan penilaian yang obyektif untuk menarik kesimpulan <i>Able to design and implement laboratory experiment and / or field experiments, analyze and interpret data, and use objective assessments to draw conclusions</i>				
	CPL-06 PLO-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>				

	Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcome (CLO) - If CLO as description capability of each Learning Stage in the course, then CLO = LLO</i>																																																																												
	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 Map of PLO - CLO	<table border="1"> <thead> <tr> <th data-bbox="409 675 705 751"></th> <th data-bbox="705 675 824 751">CPL-01</th> <th data-bbox="824 675 943 751">CPL-02</th> <th data-bbox="943 675 1061 751">CPL-03</th> <th data-bbox="1061 675 1180 751">CPL-04</th> <th data-bbox="1180 675 1299 751">CPL-05</th> <th data-bbox="1299 675 1417 751">CPL-06</th> <th data-bbox="1417 675 1536 751">CPL-07</th> <th data-bbox="1536 675 1655 751">CPL-08</th> <th data-bbox="1655 675 1774 751">CPL-09</th> <th data-bbox="1774 675 1892 751">CPL-10</th> <th data-bbox="1892 675 2011 751">CPL-11</th> <th data-bbox="2011 675 2130 751">CPL-12</th> </tr> </thead> <tbody> <tr> <td data-bbox="409 751 705 874"> 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 data-bbox="409 874 705 997"> 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 data-bbox="409 997 705 1120"> 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 data-bbox="409 1120 705 1230"> 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	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																																																																												

Short Description of Course		<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 Course Materials:		<ol style="list-style-type: none"> 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> 				
Pustaka References		<p>Utama / Main:</p> <ol style="list-style-type: none"> 1. Cooper, Rory A. "An Introduction to Rehabilitation Engineering." CRC Press. 2. Bronzino, Joseph D. "The Biomedical Engineering Handbook," CRC Press. <p>Pendukung / Supporting:</p> <ol style="list-style-type: none"> 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 <i>Lecturers</i>						
Matakuliah syarat <i>Prerequisite</i>		-				
Mg ke/ <i>Week</i>	Kemampuan akhir tiap tahap belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bantuan Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / <i>Form of Learning; Learning Method;</i> Student Assignment;	Materi Pembelajaran [Pustaka] / <i>Learning Material</i> [Reference]	Bobot Penilaian /Assess- ment Load (%)
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>			

(1)	(2)	(3)	(4)	[Estimated Time]		(7)	(8)
				Tatap Muka / In-class (5)	Daring / Online (6)		
1-4	<p>Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar perancangan robot dan aplikasi robot dalam dunia medis</p> <p><i>Students understand and are able to explain the basic concepts of robot design and robot application in the medical world</i></p>	<ul style="list-style-type: none"> ● Kelengkapan dan kerapian hasil resume ● Ketepatan waktu pengumpulan tugas. ● Kebenaran melaksanakan tugas. ● Keberhasilan menjelaskan tugas dengan baik <ul style="list-style-type: none"> ● Kelengkapan dan kerapian hasil resume ● Ketepatan waktu pengumpulan tugas. ● Kebenaran melaksanakan tugas. ● Keberhasilan menjelaskan tugas dengan baik <ul style="list-style-type: none"> ● <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> 	<p>Non-tes :</p> <p>Tugas 1: Mengerjakan soal perhitungan mengenai konsep dasar perancangan robot</p> <p>Tugas 2 : Mengenai aplikasi robot di dunia medis, hukum dan etika penggunaan robot di dunia medis</p> <p>Non-test :</p> <p>Task 1: <i>Work on calculation problems regarding the basic concepts of robot design</i></p>	<ul style="list-style-type: none"> ● 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"] 	<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"> ● 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 struktur robot (forward, inverse, remote center of motion), konsep dasar perancangan sistem kontrol robot, pemrograman robot, dasar operasi medis dan 	<p>Tugas 1 Task 1 : 5</p> <p>Tugas 2 Task 2 : 5</p>

		<ul style="list-style-type: none"> ● <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> 	<p>Task 2 : <i>Regarding the application of robots in the medical world, the law and ethics of using robots in the medical world</i></p>			<p>dasar radiologi intervensi (interventional radiology), hukum dan etika penggunaan robot dalam dunia medis</p> <p>[Link materi di MyITSClassroom]</p> <ul style="list-style-type: none"> ● <i>Course contract:</i> <ul style="list-style-type: none"> - <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, reverse, remote center of motion), basic concepts of robot control system design,</i> 	
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						robot programming, medical operations and basic interventional radiology (interventional radiology), legal and ethical use of robots in the medical world	
5-7	<p>Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar <i>Minimally Invasive Surgery (MIS)</i></p> <p><i>Students understand and are able to explain the basic concepts of Minimally Invasive Surgery (MIS)</i></p>	<ul style="list-style-type: none"> ● Kebenaran pemahaman, jawaban dan analisa ● Keberhasilan menjelaskan tugas ● Ketepatan waktu pengumpulan tugas ● Kebenaran pemahaman, jawaban dan analisa ● Keberhasilan menjelaskan tugas ● Ketepatan waktu pengumpulan tugas ● <i>Correct in understanding, answers and analysis</i> ● <i>Able to explain the assignments</i> 	<p>Non-tes : Tugas 3 : Tugas tertulis mengenai konsep dasar MIS</p> <p>Tugas 4 : Tugas tertulis mengenai konsep disain robot untuk MIS, telesurgery</p> <p>Non-test : Task 3: <i>Written assignment on basic MIS concepts</i></p>	<ul style="list-style-type: none"> ● 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, exercise, assignment</i> 3x[FF: 3 x 50"] 3x[SA: 3 x 50"] 3x[SS : 3 x 50"] 		<ul style="list-style-type: none"> ● Minimally Invasive Surgery (MIS) : 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 	<p>Tugas 3 Task 3 : 5</p> <p>Tugas 4 Task 4 : 5</p>

		<ul style="list-style-type: none"> • On time submission of assignments. • Correct in understanding, answers and analysis • Able to explain the assignments • On time submission of assignments. 	<p>Task 4: Written assignment on robot design concepts for MIS, telesurgery.</p>			<ul style="list-style-type: none"> • 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 videos in MIS , augmented reality 	
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						20
9 - 11	<p>Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar interventional radiology robot</p> <p><i>Students understand and are able to explain the basic</i></p>	<ul style="list-style-type: none"> • Kebenaran pemahaman, jawaban dan analisa • Keberhasilan menjelaskan tugas 	<p>Non-tes :</p> <p>Tugas 5 : Tugas tertulis mengenai konsep dasar radiologi dan radiologi intervensi</p>	<ul style="list-style-type: none"> • Kuliah, diskusi, tanya jawab, latihan soal, tugas 3x[TM: 3 x 50"] 3x[BM: 3 x 50"] 3x[PT: 3 x 50"] 		<ul style="list-style-type: none"> • Intervensi yang dipandu gambar : sumber-sumber gambar medika (MRI, ultrasound, sinar X, CT scan), kompatibilitas robot dengan 	<p>Tugas 5 Task 5 : 5</p> <p>Tugas 6 Task 6 : 5</p>


	<p><i>concepts of interventional radiology robots</i></p>	<ul style="list-style-type: none"> ● Ketepatan waktu pengumpulan tugas ● Kebenaran pemahaman, jawaban dan analisa ● 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> ● <i>Able to explain the assignments</i> ● <i>On time submission of assignments.</i> 	<p>Tugas 6 : Tugas tertulis mengenai konsep perancangan robot untuk operasi medis berbasis gambar</p> <p>Non-test :</p> <p>Task 5: <i>Written assignment regarding the basic concepts of radiology and interventional radiology</i></p> <p>Task 6: <i>Written assignment regarding the concept of designing robots for image-based medical surgery</i></p>	<ul style="list-style-type: none"> ● <i>Presentation, discussion, ask and answer, exercise, assignment</i> <i>3x[FF: 3 x 50"]</i> <i>3x[SA: 3 x 50"]</i> <i>3x[SS : 3 x 50"]</i> 		<p>sumber gambar medika, segmentasi dan pemodelan gambar, tracking device dan teknologi, frames and transformations, navigasi operasi medis, kalibrasi, registrasi rigid dan non-rigid, radiosurgery</p> <ul style="list-style-type: none"> ● 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, navigation of medical operations, 	
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						calibration, rigid and non-rigid registration, radiosurgery	
12 -15	<p>Mahasiswa mengetahui, memahami dan mampu menjelaskan tentang perkembangan terkini terkait robotika medika</p> <p><i>Students know, understand and are able to explain the latest developments related to medical robotics</i></p>	<ul style="list-style-type: none"> • Kebenaran pemahaman, jawaban dan analisa • Keberhasilan menjelaskan tugas • Ketepatan waktu pengumpulan tugas <ul style="list-style-type: none"> • <i>Correct in understanding, answers and analysis</i> • <i>Able to explain the assignments</i> • <i>On time submission of assignments.</i> 	<p>Non tes:</p> <p>Tugas 7 : Tugas tertulis mengenai perkembangan terkini dari penggunaan teknologi robot dalam dunia medis</p> <p>Presentasi : Penentuan tema presentasi diberikan pada minggu ke – 9. Proses presentasi dilakukan pada minggu ke – 14-15</p> <p>Non-test:</p> <p>Task 7: <i>Written assignment regarding the latest developments in the use of robotic</i></p>	<ul style="list-style-type: none"> • 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"] 		<ul style="list-style-type: none"> • 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 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</i> 	<p>Tugas 7: Task 7: : 5</p> <p>Presentasi Presentati -on : 25</p>

			<p><i>technology in the medical world.</i></p> <p>Presentation</p> <p><i>The theme for the presentation was given in the 9th week. The presentation process was carried out in the 14-15th week</i></p>			<p><i>urological system using remote surgical robots, robotic bone surgery, robotic prostate intervention, robotic catheter for cardiac surgery, etc.</i></p>	
16	<p>EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM</p>						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
Kode/code: EB184905	Bobot sks/credits (T/P): 3/0	Rumpun MK: Biocybernetics Course Cluster: Biocybernetics	Peminatan <i>Specialization</i>
OTORISASI <i>AUTHORIZATION</i>	Penyusun RA & E <i>Compiler A&EP</i> Dr. Tri Arief Sardjono, S.T., M.T.	Koordinator RMK <i>Course Cluster Coordinator</i> Ir. Josaphat Pramudijanto, M.Eng.	Ka DEP <i>Head of DEP</i> Dr. Achmad Arifin, S.T., M.Eng.

Mg ke/ Week (1)	Sub CP-MK / <i>Lesson Learning Outcomes (LLO)</i> (2)	Bentuk Asesmen (Penilaian) <i>Form of Assessment</i> (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: <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, the law and ethics of using robots in the medical world</i> Test: <i>Question 1 and 2 in Mid Exam</i>	10
2	Sub CP-MK 2:	Non-tes :	10

	<p>Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar <i>Minimally Invasive Surgery (MIS)</i></p> <p>LLO 2: <i>Students understand and are able to explain the basic concepts of Minimally Invasive Surgery (MIS)</i></p>	<p>Tugas 3 : Tugas tertulis mengenai konsep dasar MIS</p> <p>Tugas 4 : Tugas tertulis mengenai konsep disain robot untuk MIS, telesurgery</p> <p>Tes: Soal 3,4 dan 5 pada ETS Soal 1 pada EAS</p> <p>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></p> <p>Test: <i>Question 3,4 and 5 in Mid Exam</i> <i>Question 1 in Final 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>	20
9-11	<p>Sub CP-MK 3: Mahasiswa memahami dan mampu menjelaskan tentang konsep dasar interventional radiology robot</p> <p>LLO 3: <i>Students understand and are able to explain the basic concepts of interventional radiology robots</i></p>	<p>Non-tes : Tugas 5 : Tugas tertulis mengenai konsep dasar radiologi dan radiologi intervensi</p> <p>Tugas 6 : Tugas tertulis mengenai konsep perancangan robot untuk operasi medis berbasis gambar</p> <p>Tes: Soal 2 dan 3 pada EAS</p> <p>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></p> <p>Test: <i>Question 2 and 3 in Final Exam</i></p>	10
12-15	<p>Sub CP-MK 4:</p>	<p>Non tes: Tugas 7 :</p>	30

	<p>Mahasiswa mengetahui, memahami dan mampu menjelaskan tentang perkembangan terkini terkait robotika medika</p> <p>LLO 4: <i>Students know, understand and are able to explain the latest developments related to medical robotics</i></p>	<p>Tugas tertulis mengenai perkembangan terkini dari penggunaan teknologi robot dalam dunia medis</p> <p>Presentasi : Penentuan tema presentasi diberikan pada minggu ke – 9. Proses presentasi dilakukan pada minggu ke – 14-15</p> <p>Tes: Soal 4 dan 5 pada EAS</p> <p>Non-test: Task 7: <i>Written assignment regarding the latest developments in the use of robotic technology in the medical world.</i></p> <p>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></p> <p>Test: <i>Question 4 and 5 in Final Exam</i></p>	
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>	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
	CPMK 3 / <i>CLO 3</i>	Week 16	Final Exam Question 1	4
		Week- 9-11	Task 5	5
		Week- 9-11	Task 6	5
CPL-06 / <i>PLO-06</i>	CPMK 3 / <i>CLO 3</i>	Week- 16	Final Exam Question 2,3	8
		Week- 12-15	Task 7	5
		Week- 12-15	Presentation	25
		Week- 16	Final Exam Question 4,5	8
				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	0.05												0.05
2	Task 2	0.05												0.05
3	Task 3		0.05											0.05
4	Task 4		0.05											0.05
5	Task 5		0.05											0.05
6	Task 6		0.05											0.05
7	Task 7						0.05							0.05

8	<i>Presentation</i>						0.25							0.25
9	<i>Mid Exam</i>	0.08	0.12											0.20
10	<i>Final Exam</i>		0.12				0.08							0.20
	<i>Total</i>	0.18	0.44				0.38							1