

Module Handbook

Biomaterials



Bachelor Degree Program Department of Biomedical Engineering

Faculty of Intelligent Electrical Technology and Informatics
Institut Teknologi Sepuluh Nopember



MODULE HANDBOOK
Biomaterials
DEPARTMENT OF BIOMEDICAL ENGINEERING
 INSTITUT TEKNOLOGI SEPULUH NOPEMBER
 Number : B/21360/IT2.IX.5.1.2/PP.03.00.00/2020

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>	Yuli Setiyorini, S.T., M.Phil.	Dosen <i>Lecturer</i>	TTD 	November 18, 2022
Pemeriksa dan Pengendalian <i>Review and Control</i>	Fauzan Arrofiqi, S.T., M.T., Ph.D.	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

BIOMATERIALS

Module name	Biomaterials	
Module level	Undergraduate	
Code	EB234505	
Course (if applicable)	Biomaterials	
Semester	Second Semester (Genap)	
Person responsible for the module	Fauzan Arrofiqi, S.T., M.T., Ph.D.	
Lecturer	Yuli Setiyorini, S.T., M.Phil.	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, mandatory , 4 th semester	
Type of teaching, contact hours	Lectures, <60 students Mondays, 11.00-12.50 (GMT+7)	
Workload	Lectures : 3 x 50 = 150 minutes per week Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week Private learning : 3 x 60 = 180 minutes (3 hours) 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 what biomaterials is and its difference with other materials in general CLO 2: Students understand the materials used in the biology and medical fields and certain characteristics of those materials CLO 3: Students are able to explain how biomaterials interact with the body CLO 4: Students are able to explain and implement the biomaterial testing process CLO 5: Students are able to explain the application of biomaterials available in the world of medic	PLO-02 PLO-02 PLO-02 PLO-06 PLO-10
	The Biomaterials course is a compulsory course that discusses the basic sciences of materials and their classifications. This course aims	

Content / Short Description of Course	for students to understand material classifications applicable in the medical field and understand the body's natural response to biomaterial implantation.
Study and examination requirements and forms of examination	● In-class exercises ● Assignment 1, 2, 3, 4 ● Presentation ● Mid-term examination ● Final project ● Final examination
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom
Reading list	Main: ● Ratner, Buddy D., "Biomaterials Science : An Introduction to Materials in Medicine," 3rd Ed, Academic Press, 2012
	Supporting: ● Temenoff, Johnna S., "Biomaterials : The Intersection of Biology and Materials Science," 1st Ed, Prentice Hall, 2010 ● Park, Joon, "Biomaterials : An Introduction," 3rd Ed, Springer, 2007

I. Rencana Pembelajaran Semester / Semester Learning Plan

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FAKULTAS TEKNOLOGI ELEKTRO DAN INFORMATIKA CERDAS DEPARTEMEN TEKNIK BIOMEDIK				Kode Dokumen	
RENCANA PEMBELAJARAN SEMESTER							
MATA KULIAH (MK) COURSE		KODE CODE	Rumpun MK Course Cluster	BOBOT (sks) CREDITS		SEMESTER	Tgl Penyusunan Compilation Date
Biomaterial <i>Biomaterials</i>		EB234505	Biocybernetics <i>Biocybernetics</i>	T = 3 P = 0		IV	Nov 19, 2022
OTORISASI / PENGESAHAN AUTHORIZATION / ENDORSEMENT		Dosen Pengembang RPS Developer Lecturer of Semester Learning Plan		Koordinator RMK Course Cluster Coordinator		Ka DEPARTEMEN Head of Department	
		(Prof. Dr. Agung Purniawan, S.T., M.Eng.)		(Ir. Josaphat Pramudijanto, M.Eng.)		(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 PLO-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 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 learning activities others whose output is equivalent to the final assignment through logical, critical, systematic and innovative thinking.					

	CPL-06 PLO-06	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-10 PLO-10	Mampu bekerja dalam tim lintas disiplin dan budaya serta bertanggung jawab kepada masyarakat dan mematuhi hukum dan etika profesi dalam menyelesaikan masalah Teknik Biomedika <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>												
	Capaian Pembelajaran Mata Kuliah (CPMK) – Bila CP MK sebagai kemampuan pada tiap tahap pembelajaran CP MK = Sub CP MK 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 apa yang dimaksud dengan biomaterial dan perbedaannya dengan material secara general <i>Students understand what biomaterials is and its difference with other materials in general</i>												
	CP MK 2 CLO 2	Mahasiswa memahami material yang digunakan di bidang biologi dan kedokteran serta karakteristik khusus dari material tersebut <i>Students understand the materials used in the biology and medical fields and certain characteristics of those materials</i>												
	CP MK 3 CLO 3	Mahasiswa mampu menjelaskan bagaimana biomaterial berinteraksi dengan tubuh <i>Students are able to explain how biomaterials interact with the body</i>												
	CP MK 4 CLO 4	Mahasiswa mampu menjelaskan dan menerapkan proses pengujian biomaterial <i>Students are able to explain and implement the biomaterial testing process</i>												
	CP MK 5 CLO 5	Mahasiswa mampu menjelaskan aplikasi biomaterial yang telah tersedia di dunia kedokteran <i>Students are able to explain the application of biomaterials available in the world of medic</i>												
Peta CPL – CP MK Map of PLO – CLO														
		CPL-01	CPL-02	CPL-03	CPL-04	CPL-05	CPL-06	CPL-07	CPL-08	CPL-09	CPL-10	CPL-11	CPL-12	
CPMK 1 / SUB CPMK 1 CLO 1 / LLO 1			√											
CPMK 2 / SUB CPMK 2 CLO 2 / LLO 2			√											
CPMK 3 / SUB CPMK 3 CLO 3 / LLO 3			√											

	CPMK 4 / SUB CPMK 4 CLO 4 / LLO 4						√							
	CPMK 5 / SUB CPMK 5 CLO 5 / LLO 5										√			
Deskripsi Singkat MK	Mata kuliah Biomaterial merupakan mata kuliah wajib yang membahas mengenai ilmu-ilmu dasar material dan klasifikasinya. Mata kuliah ini bertujuan agar mahasiswa memahami klasifikasi material yang dapat diaplikasikan dalam bidang kedokteran dan memahami respon natural tubuh terhadap implantasi biomaterial.													
Short Description of Course	<i>The Biomaterials course is a compulsory course that discusses the basic sciences of materials and their classifications. This course aims for students to understand material classifications applicable in the medical field and understand the body's natural response to biomaterial implantation.</i>													
Bahan Kajian / Materi Pembelajaran Course Materials	1. Karakteristik material / <i>Material characteristics</i> 2. Klasifikasi dan karakteristik biomaterial / <i>Classification and characteristics of biomaterials</i> 3. Interaksi biomaterial dengan sel dan jaringan / <i>The interaction between biomaterials with cells and tissues</i> 4. Pengujian biomaterial / <i>Testing of biomaterials</i> 5. Aplikasi material di bidang kedokteran / <i>Application of materials in the medical field</i>													
Pustaka	Utama / Main :													
References	● Ratner, Buddy D., "Biomaterials Science : An Introduction to Materials in Medicine," 3rd Ed, Academic Press, 2012													
	Pendukung / Supporting:													
	● Temenoff, Johnna S., "Biomaterials : The Intersection of Biology and Materials Science," 1st Ed, Prentice Hall, 2010 ● Park, Joon, "Biomaterials : An Introduction," 3rd Ed, Springer, 2007													
Dosen Pengampu Lecturers	Yuli Setiyorini, S.T., M.Phil.													
Mata kuliah syarat Prerequisite	-													

Mg Ke/ Week	Kemampuan akhir tiap tahapan 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; Student Assignment; [Estimated Time]</i>		Materi Pembelajaran [Pustaka] / <i>Learning Material [Reference]</i>	Bobot Penilaian (%) / <i>Assessment Load (%)</i>
		Indikator / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>				
(1)	(2)	(3)	(4)	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
1	Mahasiswa memahami apa yang dimaksud dengan biomaterial dan perbedaannya dengan material secara general <i>Students understand what biomaterials is and its difference with other materials in general</i>	- Mampu mendefinisikan pengertian dasar material dan biomaterial - Mampu menjelaskan perbedaan antara material dan biomaterial - Mampu menjelaskan tentang berbagai klasifikasi material	Non-tes: Tugas 1: Melakukan klasifikasi material (Tugas Tertulis) Tes: Soal ETS (masuk dalam penilaian ETS) Non-test: Task 1: Perform material classification (Written Task)	- Kuliah, diskusi, tanya jawab, tugas [TM : 1 x 3 x 50"] [BM : 1 x 3 x 60"] [PT : 1 x 3 x 60"] - Lecture, discussion, question and answer, exercise and assignment [FF : 1 x 3 x 50"] [SA : 1 x 3 x 60"] [SS : 1 x 3 x 60"]	- Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom - Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform	- Kontrak kuliah: - Motivasi belajar - Rencana pembelajaran - Aturan-aturan perkuliahan - Tujuan perkuliahan - Sistem penilaian, buku ajar/sumber pustaka - Pengertian dasar material dan biomaterial	Tugas 1: 2.5 Task 1: 2.5

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		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>Assess-ment Load (%)</i>
		Indikator / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
		• Able to define the basic understanding of materials and biomaterials • Able to explain the difference between materials and biomaterials • Able to explain various material classifications	Test: Mid-term examination questions (included in the mid-term assessment)			• Perbedaan material dan biomaterial • Klasifikasi material [Link materi di MyITSClassroom] • Course contract: - Motivation to learn - Lesson plan - Lecture rules - Course objective - Assessment system, textbooks / library resources • Basic understanding	

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		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>Assess-ment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
(1)	(2)	(3)	(4)			<i>of materials and biomaterials</i> <i>Differences in materials and biomaterials</i> <i>Classification of materials</i> [<i>Course materials link at MyITSClassroom</i>]	
2-4	Mahasiswa memahami material yang digunakan di bidang biologi dan kedokteran serta karakteristik khusus dari material tersebut <i>Students understand the materials used in the biology and medical fields and certain characteristics of those materials</i>	- Mampu membedakan jenis material yang banyak digunakan di bidang biologi dan kedokteran - Mampu memahami karakteristik material secara umum dan biomaterial	Non-tes: Tugas 2: Klasifikasi dan karakteristik dari biomaterial (Tugas Tertulis) Tes: Soal ETS (masuk dalam penilaian ETS) Non-test:	- Kuliah, diskusi, tanya jawab, tugas [<i>TM : 3 x 3 x 50"</i>] [<i>BM : 3 x 3 x 60"</i>] [<i>PT : 3 x 3 x 60"</i>] <i>Lecture, discussion, question and answer, exercise and assignment</i>	- Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom <i>Lecture, discussion, question and answer, exercise and assignment in myITS</i>	- Jenis material yang banyak digunakan di bidang biologi dan kedokteran - Karakteristik material secara umum - Karakteristik biomaterial - Klasifikasi biomaterial	Tugas 2: 5 Task 2: 5

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bantuan 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 / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
		- Mampu melakukan klasifikasi biomaterial <i>Able to distinguish types of materials that are widely used in the fields of biology and medicine</i> <i>Able to understand material characteristics in general and biomaterials</i> <i>Able to perform biomaterial classification</i>	Task 2: <i>Classification and characteristics of biomaterials (Written Task)</i> Test: <i>Mid-term examination questions (included in the mid-term assessment)</i>	[FF : 3 x 3 x 50"] [SA : 3 x 3 x 60"] [SS : 3 x 3 x 60"]	<i>Classroom platform</i>	[Link materi di MyITSClassroom] <i>Types of materials that are widely used in the fields of biology and medicine</i> <i>General material characteristics</i> <i>Characteristics of biomaterials</i> <i>Classification of biomaterials</i> [Course materials link at MyITSClassroom]	
5-7	Mahasiswa mampu menjelaskan bagaimana	Mampu menjelaskan Interaksi	Non-tes: Tugas 3:	Kuliah, diskusi, tanya jawab, tugas	Kuliah, diskusi, tanya jawab, tugas dalam	Interaksi biomaterial	Tugas 3: 2.5

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bantuan 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 / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
	biomaterial berinteraksi dengan tubuh <i>Students are able to explain how biomaterials interact with the body</i>	biomaterial dengan sel dan jaringan tubuh • <i>Able to explain the to explain the interaction of biomaterials with cells and body tissues</i>	Interaksi biomaterial dengan sel dan jaringan tubuh (Tugas Tertulis) Tes: Soal ETS (masuk dalam penilaian ETS) Non-test: Task 3: <i>Biomaterial interactions with cells and body tissues (Written Task)</i> Test: <i>Mid-term examination questions (included in the mid-term assessment)</i>	[<i>TM : 3 x 3 x 50"</i>] [<i>BM : 3 x 3 x 60"</i>] [<i>PT : 3 x 3 x 60"</i>] • <i>Lecture, discussion, question and answer, exercise and assignment</i> [<i>FF : 3 x 3 x 50"</i>] [<i>SA : 3 x 3 x 60"</i>] [<i>SS : 3 x 3 x 60"</i>]	platform myITS Classroom • <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i>	dengan sel dan jaringan tubuh [<i>Link materi di MyITSClassroom</i>] • <i>Biomaterials interactions with cells and body tissues</i> [<i>Course materials link at MyITSClassroom</i>]	Task 3: 2.5
8	EVALUASI TENGAH SEMESTER <i>MID-SEMESTER EXAM</i>						22.5

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bantuan 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 (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
9-12	Mahasiswa mampu menjelaskan dan menerapkan proses pengujian biomaterial <i>Students are able to explain and implement the biomaterial testing process</i>	- Mampu memahami dan menjelaskan tahapan pengujian biomaterial - Mampu menerapkan teknik-teknik yang digunakan dalam pengujian biomaterial <i>Able to understand and explain the stages of biomaterial testing</i> <i>Able to apply the techniques used in biomaterial testing</i>	Non-tes: Tugas 4: Teknik-teknik pengujian biomaterial (Tugas Tertulis) Tes: Soal EAS (masuk dalam penilaian EAS) Non-test: Task 4: Biomaterial testing techniques (Written Task) Test: Final examination questions (included in the final assessment)	- Kuliah, diskusi, tanya jawab, tugas [TM : 4 x 3 x 50"] [BM : 4 x 3 x 60"] [PT : 4 x 3 x 60"] <i>Lecture, discussion, question and answer, exercise and assignment</i> [FF : 4 x 3 x 50"] [SA : 4 x 3 x 60"] [SS : 4 x 3 x 60"]	- Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i>	- Tahapan pengujian biomaterial - Teknik-teknik yang digunakan dalam pengujian biomaterial [Link materi di MyITSClassroom] <i>Stages of biomaterial testing</i> <i>Techniques used in biomaterial testing</i> [Course materials link at MyITSClassroom]	Tugas 4: 10 Task 4: 10

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		Bantuan 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 / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
13-15	Mahasiswa mampu menjelaskan aplikasi biomaterial yang telah tersedia di dunia kedokteran <i>Students are able to explain the application of biomaterials available in the world of medicine</i>	- Mampu menjelaskan aplikasi biomaterial di dunia kedokteran - Mampu menjelaskan teknologi terkini terkait penggunaan biomaterial <i>Able to explain the application of biomaterials in the medical world</i> <i>Able to explain the latest technology related to the use of biomaterials</i>	Presentasi: Topik presentasi secara umum mengenai aplikasi biomaterial di dunia kedokteran. Mahasiswa akan dibagi menjadi beberapa grup dan diminta untuk memilih topik khusus presentasi mereka (Tugas Presentasi) Final Project: Penentuan tema final project diberikan pada minggu ke – 8. Proses evaluasi final project dilakukan pada minggu ke – 15 dan 16 (Diskusi) Presentation:	- Kuliah, diskusi, tanya jawab, tugas [TM : 3 x 3 x 50"] [BM : 3 x 3 x 60"] [PT : 3 x 3 x 60"] <i>Lecture, discussion, question and answer, exercise and assignment</i> [FF : 3 x 3 x 50"] [SA : 3 x 3 x 60"] [SS : 3 x 3 x 60"]	- Kuliah, diskusi, tanya jawab, tugas dalam platform myITS Classroom <i>Lecture, discussion, question and answer, exercise and assignment in myITS Classroom platform</i>	- Aplikasi biomaterial di dunia kedokteran - Teknologi terkini terkait penggunaan biomaterial [Link materi di MyITSClassroom] <i>Application of biomaterials in medical world</i> <i>The latest technology related to the use of biomaterials</i> [Course materials link at MyITSClassroom]	Presentasi: 15 Final Project: 17.5 Presentation: 15 Final Project: 17.5

Mg Ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / Assessment		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>Assess-ment Load (%)</i>
		Indikator / Indicator	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka (5) / <i>In-class (5)</i>	Daring (6) / <i>Online (6)</i>	(7)	(8)
			<i>General presentation topics regarding the application of biomaterials in medical world. Students will be divided into several groups and asked to choose a specific topic for their presentation (Presentation Task)</i> Final Project: <i>Determination of the theme of the final project is given in week 8. The final project evaluation process is carried out on weeks 15 and 16 (Discussion)</i>				
16	EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM						25

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 : Biomaterials		RA&E Write Doc Code
Kode / Code: EB234505	Bobot sks/credits (T/P): 3/0	Rumpun MK: Biocybernetics Course Cluster: Biocybernetics	Smt: IV
OTORISASI AUTHORIZATION	Penyusun RA & E Compiler A&EP Fauzan Arrofiqi, S.T., M.T., Ph.D.	Koordinator RMK Course Cluster Coordinator Ir. Josaphat Pramudijanto, M.Eng.	Ka DEPARTEMEN Head of Department 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 apa yang dimaksud dengan biomaterial dan perbedaannya dengan material secara general LLO 1: <i>Students understand what biomaterials is and its difference with other materials in general</i>	Non-Tes: Tugas 1: Melakukan klasifikasi material (Tugas Tertulis) Tes: ETS Soal 1 (masuk dalam penilaian ETS) Non-Test: Task 1: <i>Perform material classification (Written Task)</i> Test: <i>Mid-term examination question 1 (included in the mid-term assessment)</i>	2.5
2-4	Sub CP-MK 2: Mahasiswa memahami material yang digunakan di bidang biologi dan kedokteran serta karakteristik khusus dari material tersebut LLO 2: <i>Students understand the materials used in the biology and medical fields and certain characteristics of those materials</i>	Non-Tes: Tugas 2: Klasifikasi dan karakteristik dari biomaterial (Tugas Tertulis) Tes: ETS Soal 2 dan 3 (masuk dalam penilaian ETS) Non-Test: Task 2: <i>Classification and characteristics of biomaterials (Written Task)</i> Test: <i>Mid-term examination questions 2 and 3 (included in the mid-term assessment)</i>	5
5-7	Sub CP-MK 3:	Non-Tes:	2.5

Mg ke / Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	Mahasiswa mampu menjelaskan bagaimana biomaterial berinteraksi dengan tubuh LLO 3: <i>Students are able to explain how biomaterials interact with the body</i>	Tugas 3: Interaksi biomaterial dengan sel dan jaringan tubuh (Tugas Tertulis) Tes: ETS Soal 4 dan 5 (masuk dalam penilaian ETS) Non-Test: Task 3: <i>Biomaterial interactions with cells and body tissues (Written Task)</i> Test: <i>Mid-term examination questions 4 and 5 (included in the mid-term assessment)</i>	
8	Evaluasi Tengah Semester Mid-Semester Exam	Tes: Ujian Tulis/Ujian Daring Test: <i>Written Exams/Online Examinations</i>	22.5
9-12	Sub CP-MK 4: Mahasiswa mampu menjelaskan dan menerapkan proses pengujian biomaterial LLO 4: <i>Students are able to explain and implement the biomaterial testing process</i>	Non-Tes: Tugas 4: Teknik-teknik pengujian biomaterial (Tugas Tertulis) Tes: EAS Soal 1 dan 2 (masuk dalam penilaian EAS) Non-Test: Task 4: <i>Biomaterial testing techniques (Written Task)</i> Test: <i>Final examination questions 1 and 2 (included in the final assessment)</i>	10
13-15	Sub CP-MK 5: Mahasiswa mampu menjelaskan aplikasi biomaterial yang telah tersedia di dunia kedokteran LLO 5: <i>Students are able to explain the application</i>	Presentasi: Topik presentasi secara umum mengenai aplikasi biomaterial di dunia kedokteran. Mahasiswa akan dibagi menjadi beberapa grup dan diminta untuk memilih topik khusus presentasi mereka (Tugas Presentasi) Final Project: Penentuan tema final project diberikan pada minggu ke – 8. Proses evaluasi final project dilakukan pada minggu ke – 15 dan 16 (Diskusi)	32.5

Mg ke / Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	<i>of biomaterials available in the world of medic</i>	Tes: EAS Soal 3, 4, dan 5 (masuk dalam penilaian EAS) Presentation: <i>General presentation topics regarding the application of biomaterials in medical world. Students will be divided into several groups and asked to choose a specific topic for their presentation (Presentation Task)</i> Final Project: <i>Determination of the theme of the final project is given in week 8. The final project evaluation process is carried out on weeks 15 and 16 (Discussion)</i> Test: <i>Final examination questions 3, 4, and 5 (included in the final assessment)</i>	
16	Evaluasi Akhir Semester <i>Final Exam</i>	Tes: Ujian Tulis/Ujian Daring Test: <i>Written Exams/Online Examinations</i>	25
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-03 / PLO-03	CPMK 4 / CLO 4	Week- 9	Task 4	10
		Week- 16	Final Exam Question 1-2	10
CPL-06 / PLO-06	CPMK 1 / CLO 1	Week- 1	Task 1	2.5
		Week- 8	Mid Exam Question 1	4.5
	CPMK 2 / CLO 2	Week- 2	Task 2	5
		Week- 8	Mid Exam Question 2-3	9
	CPMK 3 / CLO 3	Week- 5	Task 3	2.5
		Week- 8	Mid Exam Question 4-5	9
CPL-08 / PLO-08	CPMK 5 / CLO 5	Week- 13	Presentation	15
		Week- 15	Final Project	17.5
		Week- 16	Final Exam Question 3-5	15
				$\Sigma = 100\%$

No	Form of Assess-ment	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(3 Tugas Tulis) Assignment 1 (3 Written Assignment)		0.2											0.2
2	Evaluasi Tengah Semester Mid Exam		0.2				0.1							0.3

No	Form of Assess-ment	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
3	Tugas 2 (1 Tugas Tulis & Final Project) Assignment 2 (1 Written Assignment & Final Project)						0.2							0.2
4	Evaluasi Akhir Semester Final Exam						0.1				0.2			0.3
	Total		0.4				0.4				0.2			1

