MODULE HANDBOOK
ENGINEERING MATHEMATICS

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

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

ENDORSEMENT PAGE

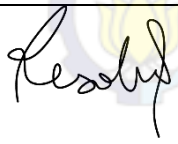
MODULE HANDBOOK

Engineering Mathematics

DEPARTMENT OF BIOMEDICAL ENGINEERING

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

Number : 6841/IT2.IX.5.1.2/B/PP.03.00.00/2023

Proses ***Process***	**Penanggung Jawab** ***Person in Charge***			**Tanggal** ***Date***
	Nama ***Name***	**Jabatan** ***Position***	**Tandatangan** ***Signature***	
Perumus *Preparation*	Dr. Norma Hermawan, S.T., M.Sc.	Dosen *Lecturer*		**November 18, 2022**
Pemeriksa dan Pengendalian *Review and Control*	Nada F. H., S.T. M.T.	Tim kurikulum *Curriculum team*		**November 20, 2022**
Persetujuan *Approval*	Ir. Josaphat Pramudijanto, M.Eng.	Koordinator RMK *Course Cluster Coordinator*		**April 13, 2023**
Penetapan *Determination*	Dr. Achmad Arifin, S.T., M.Eng.	Kepala Departemen *Head of Department*		**April 17, 2023**

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MODULE HANDBOOK
ENGINEERING MATHEMATICS

Module name	**Engineering Mathematics**	
Module level	Undergradute	
Code	EB234303	
Course (if applicable)	Engineering Mathematics	
Semester	First Semester (Gasal)	
Lecturer	Dr. Tri Arief Sardjono, S.T., M.T. M. Yazid, B.Eng., M.Eng. Nada F.H., S.T., M.T. Ir. Josaphat Pramudijanto, M.Eng. Eko Agus Suprayitno, S.Si., M.T.	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergradute degree program, **mandatory**, 3rd semester.	
Type of teaching, contact hours	Lectures, <60 students Wednesday, 14.00-16.50 (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 : 3 x 50 = 150 minutes per week.	
Credit points	3 credit points (sks)	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites	Calculus 2 (minimum score of D)	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO 1: Students are able to understand and solve any problem regarding matrices and vector. CLO 2: Students are able to implement the methods for both the first order and second order differential equation. CLO 3: Students are able to implement the high order differential equation methods. CLO 4: Students are able to understand and implement the laplace Transformation in differential equation solution.	PLO-01 PLO-05 PLO-05 PLO-06

	CLO 5: Students are able to understand and solve the differential equation system. CLO 6: Students are able to implement partially differential equation in mathematics equation.	PLO-01 PLO-06
Content	Engineering Mathematics is a mandatory course that completes an analysis capability of student to able to use advanced mathematic concepts in finding the solution of the engineering problem. This course aims the students to be able to understand the engineering problems either in the form of Differential Equation (DE) or integral, also to be able to apply the solving methods. The engineering problem is meant by problem in Biomedical Engineering disciplinary	
Study and examination requirements and forms of examination	• In-class exercises • discussion • Assignment 1, 2, 3, 4, 5, 6, 7, 8 • Quiz I, II • Mid-term examination • Final examination	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	
Reading list	Main : 1. Kreyszig, E. (2011), Advanced Engineering Mathematics 10th Edition, John Wiley & Sons, Inc. 2. Rideout, V.C. (1991), Mathematical and Computer Modeling of Physiological System, Prentice-Hall International, Inc., Wisconsin. Supporting : 1. Richard, A. (1990), Principles of Biomedical Instrumentation and Measurement, Merrilll Publishing Company, Singapore.	

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***
Matematika Teknik ***Engineering Mathematics***	EB234303	Ilmu Dasar Teknik *Basic Engineering*	T=3	P=0	III	27 Oktober 2023

OTORISASI / PENGESAHAN ***AUTHORIZATION / ENDORSEMENT***	**Dosen Pengembang RPS** ***Developer Lecturer of Semester Learning Plan***	**Koordinator RMK** ***Course Cluster Coordinator***	**Ka DEPARTEMEN** ***Head of Department***
	(Nada Fitrieyatul Hikmah, S.T, M.T)	**(Dr. Norma Hermawan, S.T., M.Sc., Ph.D.)**	**(Dr. Achmad Arifin, S.T., M.Eng.)**

Capaian Pembelajaran ***Learning Outcomes***	**CPL-PRODI yang dibebankan pada MK** ***PLO Program Charged to The Course***	
	CPL-01 *PLO-01*	Mampu **menerapkan** Ilmu Pengetahuan Alam dan Matematika pada bidang Teknik Biomedika. *Able to **apply** Natural Sciences and Mathematics in the field of Biomedical Engineering.*
	CPL-05 *PLO-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 **mengenali/memanfaatkan** sumber daya lokal dan nasional dengan wawasan global. *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	Mampu **menerapkan** ilmu pengetahuan, keterampilan, dan metode terkini dalam menyelesaikan permasalahan di bidang Teknik Biomedika.

	PLO-06	*Able to **apply** the latest knowledge, skills and methods in solving problems in the field of Biomedical Engineering.*
	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 mampu memahami dan menyelesaikan persoalan mengenai matriks dan vector. *Students are able to understand and solve any problem regarding matrices and vector.*
	CP MK 2 ***CLO 2***	Mahasiswa mampu menerapkan metode persamaan differensial orde satu dan orde 2. *Students are able to implement the methods for both the first order and second order differential equation.*
	CP MK 3 ***CLO 3***	Mahasiswa mampu menerapkan metode persamaan differensial orde tinggi. *Students are able to implement the high order differential equation methods.*
	CP MK 4 ***CLO 4***	Mahasiswa mampu memahami dan menerapkan Transformasi Laplace pada penyelesaian persamaan diferensial. *Students are able to understand and implement the laplace Transformation in differential equation solution.*
	CP MK 5 ***CLO 5***	Mahasiswa mampu memahami dan menyelesaikan sistem persamaan differensial. *Students are able to understand and solve the differential equation system.*
	CP MK 6 ***CLO 6***	Mahasiswa mampu menerapkan persamaan diferensial parsial dalam persamaan matematika *Students are able to implement partially differential equation in mathematics equation.*

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*	√											
CPMK 6 / SUB CPMK 6 *CLO 6 / LLO 6*						√						

Diskripsi Singkat MK

Short Description of Course

Mata kuliah Matematika Teknik merupakan mata kuliah wajib untuk melengkapi kemampuan analisis seorang mahasiswa agar mampu menggunakan konsep-konsep matematik lanjutan dalam mencari solusi persoalan teknik. Mata kuliah ini bertujuan agar mahasiswa mampu memahami permasalahan teknik dalam bentuk persamaan differensial (PD) atau integral, serta dapat menerapkan metode penyelesainnya. Permasalahan teknik yang dimaksud berupa permasalahan dalam disiplin ilmu Teknik Biomedik.

Engineering Mathematics is a mandatory course that completes an analysis capability of student to able to use advanced mathematic concepts in finding the solution of the engineering problem. This course aims the students to be able to understand the engineering problems either in the form of Differential Equation (DE) or integral, also to be able to apply the solving methods. The engineering problem is meant by problem in Biomedical Engineering disciplinary.

Bahan Kajian: Materi pembelajaran

Course Materials:

1. Matriks dan vector: eigenvalue, eigenvector / *Matrices and vector: eigenvalue, eigenvector*
2. Persamaan diferensial, meliputi persamaan diferensial orde 1 dan orde 2 / *Differential Equation, including 1 order and 2 orde Differential Equation*
3. Persamaan diferensial orde tinggi / *High order Differential Equation*
4. Transformasi Laplace pada penyelesaian persamaan diferensial / *Laplace Transformation in solving Differential Equation*
5. Sistem persamaan diferensial / *Differential Equation System*
6. Persamaan diferensial parsia / *Partial Differential Equation*

Pustaka ***References***	**Utama / *Main*:** 1. Kreyszig, E. (2011), Advanced Engineering Mathematics 10th Edition, John Wiley & Sons, Inc. 2. Rideout, V.C. (1991), Mathematical and Computer Modeling of Physiological System, Prentice-Hall International, Inc., Wisconsin. **Pendukung / *Supporting*:** 1. Richard, A. (1990), Principles of Biomedical Instrumentation and Measurement, Merrilll Publishing Company, Singapore.
Dosen Pengampu ***Lecturers***	Dr. Tri Arief Sardjono, S.T., M.T. M. Yazid, B.Eng., M.Eng. Nada F.H., S.T., M.T. Ir. Josaphat Pramudijanto, M.Eng. Eko Agus Suprayitno, S.Si., M.T.
Matakuliah syarat ***Prerequisite***	Calculus 2

Mg ke/ *Week*	**Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)***	**Penilaian / *Assessment***		**Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment; [Estimated Time]***		**Materi Pembelajaran [Pustaka] / *Learning Material [Reference]***	**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)**
1	Mahasiswa mampu memahami dan menyelesaikan persoalan mengenai matriks dan vector.	• Mampu menghitung penjumlahan dan perkalian matriks.	**Non-tes :** **Tugas 1:** Mengerjakan soal-soal perhitungan	• Kuliah dan brainstorming, tanya jawab, tugas.	• Chatting dan diskusi dalam forum platform ITS.	• Kontrak kuliah: - Motivasi belajar - Rencana pembelajaran	**5**

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment; [Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material [Reference]*	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)
	Students are able to understand and solve any problem regarding matrices and vector.	• Mampu menghitung matriks dan vector dengan eliminasi Gauss. • Mampu menghitung nilai eigenvector dan eigenvalue dari matriks • *Able to calculate the multiplication and addition of matrices* • *Able to do matrices and vector calculation with Gauss elimination* • *Able to calculate the value of eigenvactor and eigenvalue.*	terkait dengan penjumlahan dan perkalian matriks, mencari nilai eigenvector dan eigenvalue dari matriks (Tugas Tertulis 1) ***Non-test :*** ***Task 1:*** *Solve calculation problem regarding matrice multiplication and addition, finding both the eigenvector and eigenvalue of matrices (Written Assignment 1).*	[TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • *Presentation and brainstorming, ask and answer, assignment.* *[FF : 3 x 50"]* *[SA : 3 x 50"]* *[SS : 3 x 50"]*	• *Chat and discussion in ITS platform forum.*	- Aturan-aturan perkuliahan - Tujuan perkuliahan - Sistem penilaian, buku ajar/sumber pustaka. • Konsep matriks • Eliminasi Gauss • Matriks eigenvalue dan eigenvector **[Link materi di MyITSClassroom]** • *Course contract:* *- Motivation to learn* *- Lesson plan* *- Lecture rules* *- Course objective* *- Assessment system, textbooks / library resources* • *Matrices concept*	

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment;* *[Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material* *[Reference]*	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)
						• *Gauss Elimination* • *Eigenvalue matrices and eigenvector*	
2-5	Mahasiswa mampu menerapkan metode persamaan differensial orde satu dan orde dua. *Students are able to implement the methods for both the first order and second order differential equation.*	• Mampu menentukan metode penyelesaian persamaan differensial orde satu dengan metode separable ODE/ exact ODE/ Linear ODE • Mampu menganalisa perhitungan terkait penerapan persamaan differensial orde dua	**Non-tes :** **Tugas 2:** Mencari penyelesaian solusi ODE orde satu dengan metode separable/ exact/ linear (Tugas Tertulis 2) **Tugas 3:** Analisis perhitungan terkait	• Kuliah dan brainstorming, tanya jawab, tugas. [TM : 3 x 50”] [BM : 3 x 50”] [PT : 3 x 50”] • *Presentation and brainstorming, ask and*		• Persamaan diferensial orde satu: - Separable ODE - Exact ODE - Linear ODE • Persamaan diferensial orde dua: - Persamaan diferensial linear homogen	**20**

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment;* *[Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material* *[Reference]*	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)
		pada pemodelan rangkaian listrik • *Able to determine the solution method of first order differential equation with either separable ODE/ exact ODE/ Linear ODE* • *Able to analyze the calculation regarding second order differential equation in electric circuits model*	penerapan persamaan diferensial orde dua pada pemodelan rangkaian listrik (Diskusi) **Tes :** Quiz I ***Non-test :*** ***Task* 2:** *Finding the solution of first order ODE with one method either separable/ excact/ linear (Written Assignment 2)* ***Task* 3:** *Calculation analysis regarding the*	*answer, assignment.* *[FF : 3 x 50”]* *[SA : 3 x 50”]* *[SS : 3 x 50”]*		- Persamaan diferensial nonhomogen - Aplikasi perhitungan persamaan diferensial pada rangkaian listrik. • *First order Differential Equation:* - *Separable ODE* - *Exact ODE* - *Linear ODE* • *Second order Differential Equation:* - *Homogenous linear Differential Equation*	

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment;* *[Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material* *[Reference]*	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)
			implementation of second order Differential Equation in electric circuits model (discussion) ***Test :*** *Quiz I*			- *Nonhomogenous differential equation* - *Differential Equation application in electric circuits.*	
6 - 7	Mahasiswa mampu menerapkan metode persamaan differensial orde tinggi. *Students are able to implement the high order differential equation methods.*	• Mampu menghitung penyelesaian differensial orde tinggi: Persamaan diferensial linear homogen, Persamaan diferensial linear nonhomogen • *Able to calculate the high-order differential equation: homogenous linear differential equation,*	**Non-tes :** **Tugas 4:** Menghitung penyelesaian untuk persamaan diferensial orde tinggi (Tugas Tertulis 3). ***Non-test :*** ***Task 4:*** *Calculating the solution for the high-order*	• Kuliah dan brainstorming, tanya jawab, tugas. [TM : 3 x 50”] [BM : 3 x 50”] [PT : 3 x 50”] • *Presentation and brainstorming, ask and answer, assignment.*		• Persamaan diferensial linear homogen • Persamaan diferensial linear nonhomogen • *Homogenous linear differential equation* • *Nonhomogenous linear differential equation*	**5**

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment; [Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material [Reference]*	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)
		nonhomogenous linear differential equation	*differential equation (Written Assignment 3)*	*[FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]*			
8	**EVALUASI TENGAH SEMESTER** ***MID-SEMESTER EXAM***						**20**
9 - 10	Mahasiswa mampu memahami dan menerapkan Transformasi Laplace pada penyelesaian persamaan diferensial. *Students are able to understand and implement the Laplace Transformation in differential equation solution.*	• Mampu menyelesaikan perhitungan transformasi laplace: Linearitas, derivatif dan integral, fungsi unit step, konvolusi • *Able to resolve the problem regarding laplace transform: Linearity, derivative and integral, unit step function, convolution*	**Non-tes :** **Tugas 5:** Mengerjakan soal-soal perhitungan terkait dengan metode Transformasi Laplace (Tugas Tertulis 4). ***Non-test :*** ***Task 5:*** *Calculating the problem regarding Laplace Transform (Written Assignment 4)*	• Kuliah dan brainstorming, tanya jawab, tugas. [TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • *Presentation and brainstorming, ask and answer, assignment. [FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]*		Transformasi Laplace: • Linearitas • Derivatif dan integral • Fungsi unit step • Konvolusi. Laplace Transform: • *Linearity* • *Derivative and integral* • *Unit step function* • *Convolution*	**5**

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment; [Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material [Reference]*	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)
11 -12	Mahasiswa mampu memahami dan menyelesaikan sistem persamaan differensial *Students are able to understand and solve the differential equation system.*	• Mampu memodelkan sistem persamaan differensial mengenai sistem ODE. • *Able to model the differential equation system that is ODE system.*	**Non tes:** **Tugas 6:** Penyelesaian untuk system persamaan diferensial (Tugas Tertulis 5) **Tes :** Quiz II ***Non-test:*** ***Task 6:*** *Solution for Differential Equation system (Written Assignment 5)* ***Test :*** *Quiz II*	• Kuliah dan brainstorming, tanya jawab, tugas. [TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • *Presentation and brainstorming, ask and answer, assignment. [FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]*		Sistem persamaan diferensial: • Teori dasar mengenai system ODE: Wronskian • Pemodelan system ODE dalam bidang teknik • Sistem linear nonhomogen ODE *Differential Equation system:* • *Fundamental theory of ODE system: Wronskian* • *ODE system models in engineering fields* • *ODE nonhomogenous liniear system*	**15**

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment;* *[Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material* *[Reference]*	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)
13-15	Mahasiswa mampu menerapkan persamaan diferensial parsial dalam persamaan matematika. *Students are able to implement partial differential equation in mathematics equation.*	• Mampu menentukan metode penyelesaian persamaan differensial parsial: 1D wave and heat, 2D wave and heat, koordinat silinder dan bulat. • Mampu menyelesaikan persamaan diferensial parsial dalam bidang ilmu teknik • *Able to determine the solving method of partial differential equation: 1D wave and heat, 2D wave and heat, cylindrical and spherical coordinates* • *Able to solve the partial differential*	**Non tes:** **Tugas 7:** Mengerjakan soal-soal perhitungan mengenai persamaan diferensial parsial metode 1D wave and heat, 2D wave and heat (Tugas Tertulis 6) **Tugas 8:** Menemukan penyelesaian persamaan diferensial parsial pada kasus bidang ilmu teknik (Tugas Tertulis 7) ***Non-test:*** ***Task 7:***			Persamaan diferensial parsial: • 1D wave and heat • 2D wave and heat • Polar coordinates • Cylindrical and Spherical Coordinates *Partial differential equation:* • *1D wave and heat* • *2D wave and heat* • *Polar coordinates* • *Cylindrical and Spherical* Coordinates	**10**

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment; [Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material [Reference]*	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)
		equation in engineering field	*Calculate the problem regarding partial differential equation method 1D wave and heat, 2D wave and heat (Written Assignment 6)* ***Task 8:*** *Finding the solution of partial differential equation in engineering field (Written Assignment 7)*				
16	**EVALUASI AKHIR SEMESTER** *FINAL-SEMESTER EXAM*						**20**

TM=Tatap Muka, **PT**=Penugasan Terstuktur, **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 : Engineering Mathematics**		**RA&E** Write Doc Code
Kode/*code*: **EB234303**	**Bobot sks/*credits* (T/P): 3/0**	**Rumpun MK: Ilmu Dasar Teknik** ***Course Cluster: Basic Engineering***	Smt: III
OTORISASI ***AUTHORIZATION***	**Penyusun RA & E** ***Compiler A&EP*** **Nada Fitrieyatul H, S.T, M.T**	**Koordinator RMK** ***Course Cluster Coordinator*** **Dr. Norma Hermawan, S.T., M.Sc., Ph.D**	**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 mampu memahami dan menyelesaikan persoalan mengenai matriks dan vector. ***LLO 1:*** *Students are able to understand and solve any problem regarding matrices and vector.*	**Non-tes :** **Tugas 1:** Mengerjakan soal-soal perhitungan terkait dengan penjumlahan dan perkalian matriks, mencari nilai eigenvector dan eigenvalue dari matriks (Tugas Tertulis 1). **Tes:** Quiz I Soal 1 dan Soal 2 (5% dari Quiz I 10%) ETS Soal 1 (4% dari ETS 20%) ***Non-test :*** ***Task 1:*** *Solve calculation problem regarding matrice multiplication and addition, finding both the eigenvector and eigenvalue of matrices (Written Assignment 1).* ***Test:*** *Question 1 and Question 2 in Quiz I (5% of Quiz I 10%)* *Question 1 in Mid Exam (4% of Mid Exam 20%)*	10
2-5	**Sub CP-MK 2:** Mahasiswa mampu menerapkan metode persamaan differensial orde satu dan orde dua. ***LLO 2:*** *Students are able to implement the methods for both the first order and*	**Non-tes :** **Tugas 2:** Mencari penyelesaian solusi ODE orde satu dengan metode separable/ exact/ linear (Tugas Tertulis 2). **Tugas 3:** Analisis perhitungan terkait penerapan persamaan diferensial orde dua pada pemodelan rangkaian listrik (Diskusi) **Tes:** Quiz I Soal 3 dan Soal 4 (5% dari Quiz I 10%) ETS Soal 2 dan Soal 3 (8% dari ETS 20%)	15

Mg ke/ *Week* (1)	Sub CP-MK / *Lesson Learning Outcomes (LLO)* (2)	Bentuk Asesmen (Penilaian) *Form of Assessment* (3)	Bobot / *Load* (%) (4)
	second order differential equation.	***Non-test :*** ***Task 2:*** *Finding the solution of first order ODE with one method either separable/ excact/ linear (Written Assignment 2).* ***Task 3:*** *Calculation analysis regarding the implementation of second order Differential Equation in electric circuits model (discussion).* ***Test:*** *Question 3 and Question 4 in Quiz I (5% of Quiz I 10%)* *Question 2 and Question 3 in Mid Exam (8% of Mid Exam 20%)*	
6-7	**Sub CP-MK 3:** Mahasiswa mampu menerapkan metode persamaan differensial orde tinggi. ***LLO 3:*** *Students are able to implement the high order differential equation methods.*	**Non-tes :** **Tugas 4:** Menghitung penyelesaian untuk persamaan diferensial orde tinggi (Tugas Tertulis 3) **Tes:** ETS Soal 4 dan Soal 5 (8% dari ETS 20%) ***Non-test :*** ***Task 4:*** *Calculating the solution for the high-order differential equation (Written Assignment 3)* ***Test:*** *Questions 4 and 5 in Mid Exam (8% of Mid Exam 20%)*	5
8	**Evaluasi Tengah Semester** ***Mid Exam***	**Tes:** Ujian Tulis/Ujian Daring ***Test:*** *Writing Exams / Online Exams*	20
9-10	**Sub CP-MK 4:** Mahasiswa mampu memahami dan menerapkan Transformasi Laplace pada penyelesaian persamaan diferensial. ***LLO 4:*** *Students are able to understand and implement the Laplace*	**Non-tes :** **Tugas 5:** Mengerjakan soal-soal perhitungan terkait dengan metode Transformasi Laplace (Tugas Tertulis 4). **Tes:** Quiz II Soal 1 dan Soal 2 (5% dari Quiz II 10%) EAS Soal 1 (4% dari EAS 20%) ***Non-test :*** ***Task 5:*** *Calculating the problem regarding Laplace Transform (Written Assignment 4)* ***Test:*** *Question 1 and Question 2 in Quiz II (5% of Quiz II 10%)* *Question 1 in Final Exam (4% of Final Exam 20%)*	10

Mg ke/ *Week* (1)	Sub CP-MK / *Lesson Learning Outcomes (LLO)* (2)	Bentuk Asesmen (Penilaian) *Form of Assessment* (3)	Bobot / *Load* (%) (4)
	Transformation in differential equation solution.		
11-12	**Sub CP-MK 5:** Mahasiswa mampu memahami dan menyelesaikan sistem persamaan differensial. ***LLO 5:*** *Students are able to understand and solve the differential equation system.*	**Non-tes :** **Tugas 6:** Penyelesaian untuk system persamaan diferensial (Tugas Tertulis 5). **Tes:** Quiz II Soal 3 dan Soal 4 (5% dari Quiz II 10%) EAS Soal 2 dan Soal 3 (8% dari EAS 20%) ***Non-test:*** ***Task 6:*** *Solution for Differential Equation system (Written Assignment 5).* ***Test:*** *Question 3 and Question 4 in Quiz II (5% of Quiz II 10%)* *Question 2 and Question 3 in Final Exam (8% of Final Exam 20%)*	10
13-15	**Sub CP-MK 6:** Mahasiswa mampu menerapkan persamaan diferensial parsial dalam persamaan matematika. ***LLO 6:*** *Students are able to implement partial differential equation in mathematics equation.*	**Non-tes :** **Tugas 7:** Mengerjakan soal-soal perhitungan mengenai persamaan diferensial parsial metode 1D wave and heat, 2D wave and heat (Tugas Tertulis 6). **Tugas 8:** Menemukan penyelesaian persamaan diferensial parsial pada kasus bidang ilmu teknik (Tugas Tertulis 7). **Tes:** EAS Soal 4 dan Soal 5 (8% dari EAS 20%) ***Non-test :*** ***Task 7:*** *Calculate the problem regarding partial differential equation method 1D wave and heat, 2D wave and heat (Written Assignment 6).* ***Task 8:*** *Finding the solution of partial differential equation in engineering field (Written Assignment 7).* ***Test:*** *Question 4 and Question 5 in Final Exam (8% of Final Exam 20%)*	10
16	**Evaluasi Akhir** ***Final Exam***	**Tes:** Ujian Tulis/Ujian Daring ***Test:*** *Writing Exams / Online Exams*	20

Mg ke/ *Week* (1)	Sub CP-MK / *Lesson Learning Outcomes (LLO)* (2)	Bentuk Asesmen (Penilaian) *Form of Assessment* (3)	Bobot / *Load* (%) (4)
		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 / ***PLO charged to the course***	**CPMK** / ***Course Learning Outcome (CLO)***	**Minggu ke** / ***Week***	**Bentuk Asesmen** / ***Form of Assessment***	**Bobot** / ***Load* (%)**
CPL-01 / *PLO-01*	CPMK 1 / *CLO 1*	*Week- 1*	*Task 1*	5
		Week- 8	*Mid Exam Question 1*	4
	CPMK 2 / *CLO 2*	*Week- 2-5*	*Task 2*	5
			Quiz I	10
	CPMK 5 / *CLO 5*	*Week- 11-12*	*Task 6*	5
			Quiz II	10
		Week- 16	*Final Exam Question 2 and 3*	8
	CPMK 6 / *CLO 6*	*Week- 13-15*	*Task 7*	5
CPL-05 / *PLO-05*	CPMK 2 / *CLO 2*	*Week- 2-5*	*Task 3*	5
		Week- 8	*Mid Exam Question 2 and 3*	8
	CPMK 3 / *CLO 3*	*Week- 6-7*	*Task 4*	5
		Week- 8	*Mid Exam Question 4 and 5*	8
CPL-06 / *PLO-06*	CPMK 4 / *CLO 4*	*Week- 9-10*	*Task 5*	5
		Week- 16	*Final Exam Question 1*	4
	CPMK 6 / *CLO 6*	*Week- 13-15*	*Task 8*	5
			Final Exam Question 4 and 5	8
				∑ = 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**

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*
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	*Task 8*						0.05							**0.05**
9	*Quiz I*	0.1												**0.1**
10	*Quiz II*	0.1												**0.1**
11	*Mid Exam*	0.04				0.16								**0.2**
12	*Final Exam*	0.08					0.12							**0.2**
	Total	0.52				0.26	0.22							**1**