

Module Handbook

Engineering Mathematics



Bachelor Degree Program Department of Biomedical Engineering

Faculty of Intelligent Electrical Technology and Informatics
Institut Teknologi Sepuluh Nopember

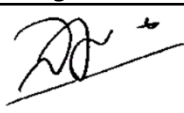
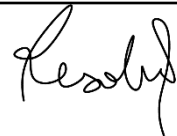


MODULE HANDBOOK

Engineering Mathematics

DEPARTMENT OF BIOMEDICAL ENGINEERING
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
Number : 6841/IT2.IX.5.1.2/B/PP.03.00.00/2023

ENDORSEMENT PAGE

Proses Process	Penanggung Jawab Person in Charge			Tanggal Date
	Nama Name	Jabatan Position	Tandatangan Signature	
Perumus <i>Preparation</i>	Dr. Norma Hermawan, S.T., M.Sc.	Dosen <i>Lecturer</i>		November 18, 2022
Pemeriksa dan Pengendalian <i>Review and Control</i>	Nada F. H., S.T. M.T.	Tim kurikulum <i>Curriculum team</i>		November 20, 2022
Persetujuan <i>Approval</i>	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

MODULE HANDBOOK

ENGINEERING MATHEMATICS

Module name	Engineering Mathematics	
Module level	Undergraduate	
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	Undergraduate degree program, mandatory , 3 rd 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, Merrill 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	
	(Ir. Josaphat Pramudijanto, M.Eng.)		(Ir. Josaphat Pramudijanto, M.Eng.)		(Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran n Learning Outcomes	CPL-PRODI yang dibebankan pada MK PLO Program Charged to The Course					
	CPL-05 PLO-05	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-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-08 PLO-08	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. <i>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.</i>
	Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO) - <i>If CLO as description capability of each Learning Stage in the course, then CLO = LLO</i>	
	CP MK 1 CLO 1	Mahasiswa mampu memahami dan menyelesaikan persoalan mengenai matriks dan vector. <i>Students are able to understand and solve any problem regarding matrices and vector.</i>
	CP MK 2 CLO 2	Mahasiswa mampu menerapkan metode persamaan differensial orde satu dan orde 2. <i>Students are able to implement the methods for both the first order and second order differential equation.</i>
	CP MK 3 CLO 3	Mahasiswa mampu menerapkan metode persamaan differensial orde tinggi. <i>Students are able to implement the high order differential equation methods.</i>
	CP MK 4 CLO 4	Mahasiswa mampu memahami dan menerapkan Transformasi Laplace pada penyelesaian persamaan diferensial. <i>Students are able to understand and implement the laplace Transformation in differential equation solution.</i>
	CP MK 5 CLO 5	Mahasiswa mampu memahami dan menyelesaikan sistem persamaan differensial. <i>Students are able to understand and solve the differential equation system.</i>
	CP MK 6 CLO 6	Mahasiswa mampu menerapkan persamaan diferensial parsial dalam persamaan matematika <i>Students are able to implement partially differential equation in mathematics equation.</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				✓								
	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 penyelesaiannya. Permasalahan teknik yang dimaksud berupa permasalahan dalam disiplin ilmu Teknik Biomedik. <i>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.</i>												
Bahan Kajian: Materi pembelajaran	1. Matriks dan vector: eigenvalue, eigenvector / <i>Matrices and vector: eigenvalue, eigenvector</i> 2. Persamaan diferensial, meliputi persamaan diferensial orde 1 dan orde 2 / <i>Differential Equation, including 1 order and 2 orde Differential Equation</i> 3. Persamaan diferensial orde tinggi / <i>High order Differential Equation</i> 4. Transformasi Laplace pada penyelesaian persamaan diferensial / <i>Laplace Transformation in solving Differential Equation</i> 5. Sistem persamaan diferensial / <i>Differential Equation System</i>												

Course Materials:	6. Persamaan diferensial parsial / <i>Partial Differential Equation</i>
Pustaka References	Utama / Main:
	1. Kreyszig, E. (2011), <i>Advanced Engineering Mathematics</i> 10th Edition, John Wiley & Sons, Inc. 2. Rideout, V.C. (1991), <i>Mathematical and Computer Modeling of Physiological System</i>, Prentice-Hall International, Inc., Wisconsin.
	Pendukung / Supporting:
	1. Richard, A. (1990), <i>Principles of Biomedical Instrumentation and Measurement</i>, Merrill 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		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami dan menyelesaikan persoalan mengenai matriks dan vector. <i>Students are able to understand and solve any problem regarding matrices and vector.</i>	• Mampu menghitung penjumlahan dan perkalian matriks. • Mampu menghitung matriks dan vector dengan eliminasi Gauss. • Mampu menghitung nilai eigenvector dan eigenvalue dari matriks • <i>Able to calculate the multiplication and addition of matrices</i> • <i>Able to do matrices and vector calculation with Gauss elimination</i> • <i>Able to calculate the value of eigenvector and eigenvalue.</i>	Non-tes : Tugas 1: Mengerjakan soal-soal perhitungan terkait dengan penjumlahan dan perkalian matriks, mencari nilai eigenvector dan eigenvalue dari matriks (Tugas Tertulis 1) Non-test : Task 1: <i>Solve calculation problem regarding matrce multiplication and addition, finding both the eigenvector and</i>	• Kuliah dan brainstorming, tanya jawab, tugas. [TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • <i>Presentation and brainstorming, ask and answer, assignment.</i> [FF : 3 x 50"] [SA : 3 x 50"] [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. • Konsep matriks • Eliminasi Gauss • Matriks eigenvalue dan eigenvector [Link materi di MyITSClassroom] • <i>Course contract:</i> - <i>Motivation to learn</i> - <i>Lesson plan</i> - <i>Lecture rules</i>	5

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)			(7)	(8)
			<i>eigenvalue of matrices (Written Assignment 1).</i>			- Course objective - Assessment system, textbooks / library resources • Matrices concept • Gauss Elimination • Eigenvalue matrices and eigenvector	
2-5	Mahasiswa mampu menerapkan metode persamaan differensial orde satu dan orde dua. <i>Students are able to implement the methods for both the first order and second order differential equation.</i>	- 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 pada pemodelan rangkaian listrik	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 differensial orde	- 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"]		- Persamaan differensial orde satu: - Separable ODE - Exact ODE - Linear ODE - Persamaan differensial orde dua: - Persamaan differensial linear homogen - Persamaan differensial nonhomogen	20

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk 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	Tatap Muka / In-class (5)	Daring / Online (6)	(7)	(8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		• 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	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/ exact/ linear (Written Assignment 2) Task 3: Calculation analysis regarding the implementation of second order Differential	[SA : 3 x 50"] [SS : 3 x 50"]		- 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 - Nonhomogenous differential equation	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)			(7)	(8)
			Equation in electric circuits model (discussion) Test : Quiz I			- Differential Equation application in electric circuits.	
6 - 7	Mahasiswa mampu menerapkan metode persamaan differensial orde tinggi. <i>Students are able to implement the high order differential equation methods.</i>	- Mampu menghitung penyelesaian differensial orde tinggi: Persamaan differensial linear homogen, Persamaan differensial linear nonhomogen - Able to calculate the high-order differential equation: homogenous linear differential equation, nonhomogenous linear differential equation	Non-tes : Tugas 4: Menghitung penyelesaian untuk persamaan differensial orde tinggi (Tugas Tertulis 3). Non-test : Task 4: Calculating the solution for the high-order differential equation (Written Assignment 3)	- 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"]		- Persamaan differensial linear homogen - Persamaan differensial 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		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						20
9 - 10	Mahasiswa mampu memahami dan menerapkan Transformasi Laplace pada penyelesaian persamaan diferensial. <i>Students are able to understand and implement the Laplace Transformation in differential equation solution.</i>	- 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
11 -12	Mahasiswa mampu memahami dan	Mampu memodelkan sistem persamaan	Non tes: Tugas 6:	Kuliah dan brainstorming,		Sistem persamaan diferensial:	15

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	menyelesaikan sistem persamaan differensial <i>Students are able to understand and solve the differential equation system.</i>	differensial mengenai sistem ODE. • <i>Able to model the differential equation system that is ODE system.</i>	Penyelesaian untuk system persamaan differensial (Tugas Tertulis 5) Tes : Quiz II Non-test: Task 6: Solution for Differential Equation system (Written Assignment 5) Test : Quiz II	tanya jawab, tugas. [TM : 3 x 50"] [BM : 3 x 50"] [PT : 3 x 50"] • <i>Presentation and brainstorming, ask and answer, assignment.</i> [FF : 3 x 50"] [SA : 3 x 50"] [SS : 3 x 50"]		• Teori dasar mengenai system ODE: Wronskian • Pemodelan system ODE dalam bidang teknik • Sistem linear nonhomogen ODE <i>Differential Equation system:</i> • <i>Fundamental theory of ODE system: Wronskian</i> • <i>ODE system models in engineering fields</i> • <i>ODE nonhomogenous liniear system</i>	
13-15	Mahasiswa mampu menerapkan persamaan	• Mampu menentukan metode penyelesaian persamaan	Non tes: Tugas 7:			Persamaan differensial parsial: • 1D wave and heat	10

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assessment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques	Tatap Muka / In-class (5)	Daring / Online (6)		
(1)	(2)	(3)	(4)			(7)	(8)
	diferensial parsial dalam persamaan matematika. <i>Students are able to implement partial differential equation in mathematics equation.</i>	diferensial parsial: 1D wave and heat, 2D wave and heat, koordinat silinder dan bulat. • Mampu menyelesaikan persamaan diferensial parsial dalam bidang ilmu teknik • <i>Able to determine the solving method of partial differential equation: 1D wave and heat, 2D wave and heat, cylindrical and spherical coordinates</i> • <i>Able to solve the partial differential equation in engineering field</i>	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:			• 2D wave and heat • Polar coordinates • Cylindrical and Spherical Coordinates <i>Partial differential equation:</i> • 1D wave and heat • 2D wave and heat • Polar coordinates • Cylindrical and Spherical Coordinates	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk 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	Tatap Muka / In-class (5)	Daring / Online (6)	(7)	(8)
(1)	(2)	(3)	(4)				
			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 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 : 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 Fitriyatul 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. Norma Hermawan, S.T., M.Sc.	

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: <i>Students are able to understand and solve any problem regarding matrices and vector.</i>	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: <i>Solve calculation problem regarding matrice multiplication and addition, finding both the eigenvector and eigenvalue of matrices (Written Assignment 1).</i> Test: <i>Question 1 and Question 2 in Quiz I (5% of Quiz I 10%)</i> <i>Question 1 in Mid Exam (4% of Mid Exam 20%)</i>	10
2-5	Sub CP-MK 2: Mahasiswa mampu menerapkan metode persamaan differensial orde satu dan orde dua. LLO 2: <i>Students are able to implement the</i>	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:	15

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

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	LLO 4: Students are able to understand and implement the Laplace Transformation in differential equation solution.	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%)	
11-12	Sub CP-MK 5: Mahasiswa mampu memahami dan menyelesaikan sistem persamaan diferensial. 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:	10

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
		<i>Finding the solution of partial differential equation in engineering field (Written Assignment 7).</i> Test: <i>Question 4 and Question 5 in Final Exam (8% of Final Exam 20%)</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>	<i>Week- 1</i>	<i>Task 1</i>	5
		<i>Week- 8</i>	<i>Mid Exam Question 1</i>	4
	CPMK 2 / <i>CLO 2</i>	<i>Week- 2-5</i>	<i>Task 2</i>	5
			<i>Quiz I</i>	10
	CPMK 5 / <i>CLO 5</i>	<i>Week- 11-12</i>	<i>Task 6</i>	5
			<i>Quiz II</i>	10
		<i>Week- 16</i>	<i>Final Exam Question 2 and 3</i>	8
	CPMK 6 / <i>CLO 6</i>	<i>Week- 13-15</i>	<i>Task 7</i>	5
CPL-05 / <i>PLO-05</i>	CPMK 2 / <i>CLO 2</i>	<i>Week- 2-5</i>	<i>Task 3</i>	5
		<i>Week- 8</i>	<i>Mid Exam Question 2 and 3</i>	8
	CPMK 3 / <i>CLO 3</i>	<i>Week- 6-7</i>	<i>Task 4</i>	5
		<i>Week- 8</i>	<i>Mid Exam Question 4 and 5</i>	8
CPL-06 / <i>PLO-06</i>	CPMK 4 / <i>CLO 4</i>	<i>Week- 9-10</i>	<i>Task 5</i>	5
		<i>Week- 16</i>	<i>Final Exam Question 1</i>	4
	CPMK 6 / <i>CLO 6</i>	<i>Week- 13-15</i>	<i>Task 8</i>	5
			<i>Final Exam Question 4 and 5</i>	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 (Tugas Tulis 1- 4) Assignment 1 (Written Assignment 1 - 4)		0		0.1				0.1					0.2
2	Evaluasi Tengah Semester Mid Exam		0		0.05				0.25					0.3
3	Tugas 2 (Tugas Tulis 5 - 8) Assignment 2 (Written Assignment 5 - 8)		0.1		0.05				0.05					0.2
4	Evaluasi Akhir Semester Final Exam		0.2		0.1				0					0.3
	Total		0.3		0.3				0.4					1

