INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCE AND DATA ANALYTICS DEPARTMENT OF MATHEMATICS		Document Code

SEMESTER LEARNING PLAN

MATA KULIAH (MK) *COURSE*	KODE *CODE*	Rumpun MK *Course Cluster*	BOBOT (sks) Credits		SEMESTER	Tgl Penyusunan *Compilation Date*
Analisis Numerik *Numerical Analysis*	KM186112	Ilmu Komputer *Computer Science*	3	P=0	1	Feb 27, 2020

OTORISASI / PENGESAHAN *AUTHORIZATION / ENDORSEMENT*	Dosen Pengembang RPS *Developer Lecturer of Semester Learning Plan*	Koordinator RMK *Course Cluster Coordinator*	Ka DEPARTEMEN *Head of Department*
	Dr. Dwi Ratna Sulistyaningrum, S.Si., M.T.	Prof. Dr. Drs. M. Isa Irawan, MT	Subchan, Ph.D

Capaian Pembelajaran *Learning Outcomes*	CPL-PRODI yang dibebankan pada MK *ILO Program Charged to The Course*	
	3.1.3	Mampu menguasai dan mengembangkan konsep-konsep matematika bidang matematika komputasi *Able to master and develop mathematical concepts in the field of computational mathematics*
	3.2.3	Mampu mengkonstruksi algoritma komputasi untuk menyelesaikan permasalahan yang terkait *Able to construct computational algorithms to solve related problems*
	4.1.3	Mampu menerapkan pokok-pokok matematika bidang Komputasi untuk mendukung riset bidang lingkungan, pemukiman, kelautan, energi, atau teknologi informasi *Able to apply mathematical principles in the field of Computing to support research in the fields of environment, settlement, marine, energy, or information technology*

4.2.2	Mampu melakukan uji/simulasi secara numerik untuk mengetahui kinerja suatu metode komputasi
	Able to perform numerical tests/simulations to determine the performance of a computational method

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 menganalisa galat dan kekovergenannya dari suatu penyelesaian numerik *Students are able to analyze errors and convergence of a numerical solution*
CP MK 2 *CLO 2*	Mahasiswa mampu secara aktif menyusun algoritma penyelesaian masalah matematika dengan pendekatan numerik *Students are able to actively construct mathematical problem solving algorithms with some numerical approach*
CP MK 3 *CLO 3*	Mahasiswa dapat mengimplementasikan pendekatan numerik ke dalam bahasa pemrograman MATLAB untuk menyelesaikan masalah-masalah matematika *Students are able can implement numerical approach to a programming language such as MATLAB to solve some problems in mathematics*
CP MK 4 *CLO 4*	Mahasiswa mampu menerapkan pendekatan numerik untuk berbagai aplikasi multidisiplin sains dan teknologi *Students are able to apply numerical approach to various multidisciplinary applications in science and technology*

Peta CPL – CP MK		CPL-01	CPL-02	CPL-03	CPL-04	CPL-05	CPL-06	CPL-07	CPL-08	CPL-09	CPL-10	CPL-11	CPL-12
Map of ILO - CLO	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	Mata kuliah komputasi numerik merupakan yang memberi kesempatan ke mahasiswa untuk dapat menyelesaikan permasalahan matematika secara numerik. Mata kuliah ini membahas tentang galat, interpolasi,turnan dan pengintegralan numerik, persamaan diferensial biasa (masalah nilai awal), dan persamaan diferensial parsial.
Short Description of Course	*The course gives an opportunity to the students to understand the methods to solve the problems in numerical mathematics. This course discusses the error, interpolation, numerical differentiation and numerical integration, numerical solution of ordinary differential equations (initial value problems), and numerical solution of partial differential equations.*
Bahan Kajian: Materi pembelajaran *Course Materials:*	1. Analisis error 2. Interpolasi 3. Turunan Numerik 4. Integral Numerik 5. Penyelesaian numerik persamaan diferensial 1. *Error analysis* 2. *Interpolation*

			3. *Numerical derivative*
			4. *Numerical Integration*
			5. *Numerical solution of differential equations*

Pustaka *References*	**Utama /** *Main***:**						
	1. R. L. Burden and J. D. Faires, Numerical Analysis, 9th edition, Brooks-Cole,						
	2. Kendall Atkinson and Weimin Han, Elementary Numerical Analysis, 2nd edition, John Wiley & Sons, Inc						
	3. Steven Chapra & Canale, Numerical methods for engineering, 4th edition, McGraw-Hill, 2002						
	Pendukung / *Supporting***:**						
	-						
Dosen Pengampu *Lecturers*	Dr. Dwi Ratna Sulistyaningrum, S.Si., M.T.						
Matakuliah syarat *Prerequisite*	-						

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*	**Tatap Muka /** *In-class* (5)	**Daring /** *Online* (6)		
(1)	**(2)**	**(3)**	**(4)**			**(7)**	**(8)**

1	Mahasiswa mampu menganalisis error dan konvergensinya dari permasalahan numerik *Students are able to analyze error and its convergence from numerical problems*	Kemampuan yang baik dalam menganalisis error dan konvergensinya *Good ability to analyze error and its convergence*	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion* • *Practice*	Ceramah Diskusi Penugasan *Lecture* *Discussion* *Assignment*	• Chatting dan diskusi dalam forum platform ITS. • *Chat and discussion in ITS platform forum.*	- Kontrak Kuliah - Analisis error - Konvergensi **[1]: Stoer Bab I** - *Contract* - *Error analysis* - *Convergences* *[1]: Stoer Chapter I*	
2-3	Mahasiswa mampu menjelaskan, membuat algoritma dan mengimplementasikan tentang interpolasi numerik *Students are able to explain, create algorithms, and implement about numerical interpolation*	Kemampuan membuat algoritma dan mengimplementasikan tentang interpolasi numerik *Ability to create algorithms and implement about numerical interpolation*	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion* • *Practice*	Ceramah Diskusi Penugasan *Lecture* *Discussion* *Assignment*	• Chatting dan diskusi dalam forum platform ITS. • *Chat and discussion in ITS platform forum.*	Interpolasi: • Polinom Interpolasi Lagrange • Polinom Interpolasi Beda Terbagi Newton. • Polinom Interpolasi Spline Linear • Polinom Interpolasi Spline Kuadratik *Interpolation* • *Lagrange Interpolation Polynomials* • *Newton's Devided Difference Interpolation Polynomials*	

| | | | | | | *Linear Spline Interpolation Polynomials* *Quadratic Spline Interpolation Polynomials* | |
| 4 – 5 | Mahasiswa mampu menjelaskan, membuat algoritma dan mengimplementasikan diferensiasi numerik

Students are able to explain, create algorithms, and implement numerical differentiation | Mampu menyelesaikan dan mengimplementasikan Diferensial Numerik

Able to solve and implement Numerical Differentiation | Tugas Diskusi Praktikum *Exercises* *Discussion* *Practice* | Ceramah Diskusi Penugasan

Lecture Discussion Assignment | Chatting dan diskusi dalam forum platform ITS. *Chat and discussion in ITS platform forum.* | Diferensiasi numerik:
- Metode Selisih Maju/Mundur/ Pusat,
- Aturan Newton-Cotes,
- Ekstrapolasi Richardson,
- Turunan Tingkat Tinggi :
[1]: Stoer Bab III
[2]: Burden Bab IV
[2]: Karris Bab X

Numerical Differentiation:
- Forward, Backward, Center Difference Method
- Newton-Cotes Rules
- Richardson Extrapolation
- High level derivative
[1]: Stoer Chapter III
[2]: Burden Chapter IV | |

						[2]: Karris Chapter X	
6 – 7	Mahasiswa mampu menjelaskan, membuat algoritma dan mengimplementasikan integrasi numerik *Students are able to explain, create algorithms, and implement numerical integration*	Mampu menyelesaikan dan mengimplementasikan integrasi numerik *Able to solve and implement numerical integration*	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion* • *Practice*	Ceramah Diskusi Penugasan *Lecture Discussion Assignment*	• Chatting dan diskusi dalam forum platform ITS. • *Chat and discussion in ITS platform forum.*	Metode integrasi numerik: • Metode Trapezoidal • Metode Simpson • Aturan rekursif • Romberg • Adatif Quadrature **[1]: Stoer Bab III** **[2]: Burden Bab IV** **[2]: Karris Bab X** *Numerical Integration Methods:* • *Trapezoidal Methods* • *Simpson Methods* • *Recursive Rules* • *Romberg* • *Adatif Quadrature* **[1]: Stoer Chapter III** **[2]: Burden Chapter IV** **[2]: Karris Chapter X**	
8	• EVALUASI TENGAH SEMESTER • *MID-SEMESTER EXAM*						30
9	Mahasiswa mampu memahami dan menganalisa dasar-dasar teori masalah nilai awal	Kemampuan yang baik dalam memahami dan menganalisa masalah nilai awal	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion*	Kuliah, Latihan Soal *Lecture Exercises*	• Chatting dan diskusi dalam forum platform ITS.	Dasar-dasar teori masalah nilai awal **[1]: Burden Bab V** *Basics of initial value problems theory*	

	Students are able to understand and anylize the theoretical basics of the initial value problems	*Good ability to understand and analyze initial value problems*	• *Practice*		• *Chat and discussion in ITS platform forum.*	*[1]: Burden Chapter V*	
10 - 13	Mahasiswa mampu membuat algoritma dan mengimplementasikan beberapa metode penyelesaian masalah nilai awal *Students are able to create algorithms and implement some initial value problems solving methods*	Kemampuan yang baik memahami dan menganalisa beberapa metode penyelesaian masalah nilai awal *Good ability to understand and analyze some initial value problems solving methods*	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion* • *Practice*	Kuliah, Responsi, Praktikum *Lecture, Responsiveness, Practice*	• Chatting dan diskusi dalam forum platform ITS. • Chat and discussion in ITS platform forum.	• Metode Euler, Taylor, Adam, Milne Metode Heun, Runge-Kutta, Multi-step **[1]: Stoer Bab VII** **[2]: Burden Bab V** **[2]: Karris Bab IX** • *Euler Method, Taylor, Adam, Milne Method Heun, Runge-Kutta, Multi-step* ***[1]: Stoer Chapter VII*** ***[2]: Burden Chapter V*** ***[2]: Karris Chapter IX***	
14	Mahasiswa mampu membuat algoritma dan mengimplementasikan beberapa metode penyelesaian PD orde tinggi *Students are able to create algorithm and implement some high-order differential equation solving problems*	Kemampuan yang baik memahami dan menganalisa beberapa metode penyelesaian PD orde tinggi *Good ability to undertand and anaylize some high-order differential*	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion* • *Practice*	Kuliah, Responsi, Praktikum *Lecture, Responsiveness, Practice*	• Chatting dan diskusi dalam forum platform ITS. • Chat and discussion in ITS platform forum.	- Transformasi PD order tinggi menjadi PD order satu • Contoh aplikasi PD order tinggi - *High-order differential equation transformation to*	

		equation solving problems				*first-order differential equation* • *High-order differential equation example*	
15	Mahasiswa mampu membuat algoritma dan mengimplementasikan metode penyelesaian Permasalahan Nilai Batas *Students are able to create algorithms and implement Boundary Value Problems solving methods*	Kemampuan yang baik memahami dan menganalisa beberapa metode penyelesaian masalah nilai batas *Good ability to understand and analyze some boundary value problems solving methods*	• Tugas • Diskusi • Praktikum • *Exercises* • *Discussion* • *Practice*	Kuliah, Responsi, Praktikum *Lecture, Responsiveness, Practice*	• Chatting dan diskusi dalam forum platform ITS. • *Chat and discussion in ITS platform forum.*	- Metode Shooting - Metode Finite-Difference - *Shooting Method* - *Finite-Difference Method*	
16	**EVALUASI AKHIR SEMESTER** ***FINAL-SEMESTER EXAM***						1

TM=Tatap Muka, **PT**=Penugasan Terstuktur, **BM**=Belajar Mandiri.
*FF = Face to Face, **SA** = Structured Assignment, **SS** = Self Study.*