	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF MATHEMATICS**	**Kode Dokumen**

RENCANA PEMBELAJARAN SEMESTER/ SEMESTER LEARNING PLAN

MATA KULIAH (MK) ***COURSE***	**KODE** ***CODE***	**Rumpun MK** ***Course Cluster***	**BOBOT (sks)** ***Credits***		**SEMESTER** ***Semester***	**Tgl Penyusunan** ***Compilation Date***
Kalkulus Stokastik *Stochastic Calculus*	KM186219	Matematika Terapan *Applied Mathematics*	3		2	
OTORISASI / PENGESAHAN ***AUTHORIZATION / ENDORSEMENT***	**Dosen Pengembang RPS** ***Developer Lecturer of Semester Learning Plan***		**Koordinator RMK** ***Course Cluster Coordinator***		**Ka DEPARTEMEN** ***Head of Department***	
			(Jika ada) Tanda tangan		Tanda tangan	

Capaian Pembelajaran ***Learning Outcomes***	**CPL-PRODI yang dibebankan pada MK** ***ILO Program Charged to The Course***	
	3.1.2	Mampu menguasai dan mengembangkan konsep-konsep matematika bidang pemodelan dan optimasi sistem *Able to master and develop mathematical concepts in the field of system modeling and optimization*
	3.2.2	Mampu memformulasikan masalah nyata dalam model matematika *Able to formulate real problems in mathematical models*
	4.1.1	Mampu menerapkan pokok-pokok matematika bidang analisis dan aljabar terapan untuk mendukung riset bidang matematika dan bidang lain *Able to apply mathematical principles in the fields of applied analysis and algebra to support research in mathematics and other fields*
	4.1.2	Mampu menerapkan pokok-pokok matematika bidang pemodelan dan optimasi sistem untuk mendukung riset bidang lingkungan,

		pemukiman, kelautan, energi, atau teknologi informasi *Able to apply mathematical principles in the field of system modeling and optimization to support research in the environmental, residential, marine, energy, or information technology fields*
	4.2.1	Mampu melakukan kajian tentang keakuratan suatu model matematis dari suatu permasalahan inter- atau multi-disiplin *Able to conduct studies on the accuracy of a mathematical model of an inter- or multi-disciplinary problem*
	Capaian Pembelajaran Mata Kuliah (CPMK) */ Course Learning Outcome (CLO)* Bila CP MK sbg penjabaran kemampuan setiap Tahap Pembelajaran dalam MK maka CPMK = Sub CPMK *If CLO as description capability of each Learning Stage in the course, then CLO = Lesson Learning Outcome (LLO)*	
	CPMK-1 *CLO-1*	Mahasiswa mampu memahami konsep dasar peluang *Students are able to understand the basic concepts of opportunity*
	CPMK-2 *CLO-2*	Mahasiswa mampu memahami konsep proses stokastik diskrit dan martingale secara diskrit *Students are able to understand the concept of discrete stochastic and martingale processes*
	CPMK-3 *CLO-3*	Mahasiswa mengenal konsep Markov dan aplikasinya *Students are familiar with the Markov concept and its application*
	CPMK-4 *CLO-4*	Mahasiswa mengenal konsep Brownian motion dan martingale secara kontinu *Students know the concepts of Brownian motion and martingale continuously*
	CPMK-5 *CLO-5*	Mahasiswa mengenal konsep kalkulus Ito dan aplikasinya di bidang keuangan *Students are familiar with Ito's calculus concept and its application in finance*

<table>
<tr><td>Peta CPL – CP MK

Map of ILO - CLO</td><td>Tuliskan peta matriks antara CPL dengan CPMK (Sub CP MK)

<table>
<tr><th></th><th>CPL-1</th><th>CPL-2</th><th>CPL-3</th><th>CPL-4</th><th>CPL-5</th><th>CPL-6</th></tr>
<tr><td>CPMK-1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CPMK-2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CPMK-3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CPMK-4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CPMK-5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Diskripsi Singkat MK

Short Description of Course</td><td>Pada mata kuliah ini disajikan konsep proses stokastik untuk memahami teori keuangan modern. Topik yang disajikan meliputi konsep dasar peluang, variable acak, distribusi diskrit dan kontinyu, dan Markov chain. Selanjutnya diperkenalkan konsep martingale, Brownian motion, dan kalkulus Ito yang mendasari teori keuangan modern

This course presents the concept of stochastic processes to understand modern financial theory. The topics presented include the basic concepts of probability, random variables, discrete and continuous distributions, and the Markov chain. Furthermore, the concept of Martingale, Brownian motion, and Ito's calculus that underlies modern financial theory is introduced</td></tr>
<tr><td>Bahan Kajian:
Materi pembelajaran

Course Materials:</td><td>• Probabilitas
• Integral Stokastik
• Persamaan Diferensial Stokastik

• Probability
• Stochastic integrals
• Stochastic differential equations</td></tr>
<tr><td>Pustaka

References</td><td>Utama:
1. Syamsuddin, “Matematika Keuangan”, Lecturer Notes
2. Brzezniak and Zastawniak, “Basic Stochastic Processes”, Springer, 1999
3. Shreve, Steven, “Stochastic Calculus for Finance, a Continuous Time Model”, Springer, 2004
Pendukung:
1. Medina and Merino, “Mathematical Finance and Probability, A Discrete Introduction”, Birkhauser Verlag, 2003
2. Kelbaner, FC, “Introduction to Stochastics Calculus with Applications”, Imperial College Press, 2005</td></tr>
<tr><td>Dosen Pengampu</td><td>Endah R. M. Putri, S.Si., M.T., Ph.D.</td></tr>
</table>

Lecturers	
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***				
(1)	**(2)**	**(3)**	**(4)**	**Tatap Muka /** ***In-class* (5)**	**Daring /** ***Online* (6)**	**(7)**	**(8)**
1	Mahasiswa mampu menjelaskan konsep probabilitas *Students are able to explain the concept of probability*	Kemampuan yang baik dalam menjelaskan konsep probabilitas dan variable random *Good ability to explain the concept of probability and random variables*	Tulisan tentang solusi beberapa permasalahan yang diberikan *Writing about solutions to some of the problems given*	• Kuliah Pengantar • Responsi • *Introductory Lectures* • *Responsiveness*	zoom myITS Classroom *zoom myITS Classroom*	- Kontrak Kuliah - Probabilitas dan variable random **[2]: Zawstaniak Bab 1** **[3]: Shreve Bab 1** *- College Contract* *- Probability and random variables* ***[2]: Zawstaniak Chapter 1*** ***[3]: Shreve Chapter 1***	*kosong*
2-3	Mahasiswa mampu menjelaskan konsep ekspektasi bersyarat *Students are able to explain*	Kemampuan yang baik dalam menjelaskan konsep ekspektasi bersyarat *Good ability in explaining*	Tulisan tentang solusi beberapa permasalahan yang diberikan *Writing about*	• Kuliah • Responsi	zoom myITS Classroom *zoom myITS Classroom*	- Dasar-dasar ekspektasi bersyarat pada event, variable random diskrit, sigma field **[2]: Zawstaniak Bab 2** **[3]: Shreve Bab 2**	

	the concept of conditional expectations	*the concept of conditional expectations*	*solutions to some of the problems given*	• *Lectures* • *Responsiveness*		*- Fundamentals of conditional expectations on events, discrete random variables, sigma field* ***[2]: Zawstaniak Chapter 2*** ***[3]: Shreve Chapter 2***	
4-6	Mahasiswa mampu menjelaskan konsep dasar field, sigma-field, filtrasi,martingale dalam waktu diskrit *Students are able to explain the basic concepts of field, sigma-field, filtration, martingale in discrete time*	Kemampuan yang baik dalam menjelaskan konsep dasar field, sigma-field, filtrasi , martingale dalam waktu diskrit dan terapannya *Good ability in explaining basic concepts of field, sigma-field, filtration, martingale in discrete time and its applications*	Tulisan tentang solusi beberapa permasalahan yang diberikan *Writing about solutions to some of the problems given*	• Kuliah • Responsi • *Lectures* • *Responsiveness*	zoom myITS Classroom *zoom myITS Classroom*	Barisan variable random, filtrasi **[2]: Zawstaniak Bab 2** **[3]: Shreve Bab 2** **[1]: Syamsuddin Bab 1,2** *Variable random sequence, filtration* ***[2]: Zawstaniak Chapter 2*** ***[3]: Shreve Chapter 2*** ***[1]: Syamsuddin Chapter 1,2***	
7-9	• Mahasiswa mampu menjelaskan konsep dasar ukuran dan integral Lebesgue • Mahasiswa mampu memahami keguanaan ukuran dan integral Lebesgue pada ruang	Kemampuan yang baik dalam menjelaskan konsep dasar ukuran dan integral Lebesgue	Tulisan tentang solusi beberapa permasalahan yang diberikan	• Kuliah • Responsi	zoom myITS Classroom	- Ukuran Lebesgue - Integral Lebesgue **[2]: Zawstaniak Bab 4** **[3]: Shreve Bab 2** **[1]: Syamsuddin Bab 3** *- Lebesgue size*	

	probabilitas • *Students are able to explain the basic concepts of Lebesgue size and integrals* • *Students are able to understand the utility of Lebesgue size and integrals in probability spaces*	*Good ability in explaining the basic concepts of Lebesgue size and integrals*	*Writing about solutions to some of the problems given*	• *Lectures* • *Responsiveness*	*zoom myITS Classroom*	*- Integral Lebesgue* ***[2]: Zawstaniak Chapter 4*** ***[3]: Shreve Chapter 2*** ***[1]: Syamsuddin Chapter 3***	
8	EVALUASI TENGAH SEMESTER *Mid Semester Evaluation*						
10-11	Mahasiswa mampu menjelaskan konsep dasar ruang probabilitas *Students are able to explain the basic concepts of probability space*	Kemampuan yang baik dalam menjelaskan konsep dasar ruang probabilitas dan aplikasinya *Good ability in explaining the basic concepts of probability space and its applications*	Tulisan tentang solusi beberapa permasalahan yang diberikan. *Writing about solutions to some of the problems given.*	• Kuliah • Responsi • *Lectures* • *Responsiveness*	zoom myITS Classroom *zoom myITS Classroom*	Ruang probabilitas **[2]: Zawstaniak Bab 2** **[3]: Shreve Bab 2** **[1]: Syamsuddin Bab 4** *Probability space* ***[2]: Zawstaniak Chapter 2*** ***[3]: Shreve Chapter 2*** ***[1]: Syamsuddin Chapter 4***	
12	Mahasiswa mampu menjelaskan ekspektasi bersyarat dalam proses stokastik *Students are able to explain conditional expectations in the stochastic process*	Kemampuan yang baik dalam menjelaskan implementasi ekspektasi bersyarat dalam proses stokastik *Good ability to explain the implementation of conditional expectations*	Tulisan tentang solusi terhadap permasalahan yang diberikan *Writing about solutions to some of the problems given.*	• Kuliah • Responsi • *Lectures* • *Responsiveness*	zoom myITS Classroom *zoom myITS Classroom*	Ekspektasi bersyarat terhadap variable acak diskret **[2]: Zawstaniak Bab 2** **[3]: Shreve Bab 2** **[1]: Syamsuddin Bab 5** *Conditional expectations of*	

		in stochastic processes				*discrete random variables* ***[2]: Zawstaniak Chapter 2*** ***[3]: Shreve Chapter 2*** ***[1]: Syamsuddin Chapter 5***	
13	• Mahasiswa mampu men-jelaskan konsep dasar martingale • Mahasiswa mampu men-jelaskan konsep dasar teorema Radon-Nikodym • *Students are able to explain the basic concepts of Martingale* • *Students are able to explain the basic concepts of the Radon-Nikodym theorem*	Kemampuan yang baik dalam menjelaskan konsep dan implementasi martingale dan Teorema Radon-Nikodym *Good ability in explaining the concept and implementation of martingale and Radon-Nikodym theorem*	Tulisan tentang solusi beberapa permasalahan yang diberikan *Writing about solutions to some of the problems given.*	• Kuliah • Responsi • *Lectures* • *Responsiveness*	zoom myITS Classroom *zoom myITS Classroom*	• Martingale • Teorema Radon-Nikodym **[2]: Zawstaniak Bab 2** **[3]: Shreve Bab 2** **[1]: Syamsuddin Bab 6,7** • *Martingale* • *Radon-Nikodym Theorem* ***[2]: Zawstaniak Chapter 2*** ***[3]: Shreve Chapter 2*** ***[1]: Syamsuddin Chapter 6,7***	
14-15	Mahasiswa mampu menjelaskan konsep dasar integral Ito dan implementasinya dalam rumus Ito dan Brownian motion *Students are able to explain*	Kemampuan yang baik dalam menjelaskan konsep dan implementasi integral Ito dan Brownian motion *Good ability in explaining*	- Tulisan tentang solusi beberapa permasalahan yang diberikan - Makalah implementasi Brownian	- Kuliah - Responsi - Tugas implementasi Brownian motion untuk menggambarkan aliran informasi dan peluang	zoom myITS Classroom *zoom myITS Classroom*	• Integral Ito • Brownian motion **[2]: Zawstaniak Bab 7** **[3]: Shreve Bab 3,4** **[1]: Syamsuddin Bab 8,9**	

	the basic concept of Ito's integral and its implementation in the Ito formula and Brownian motion	*the concept and implementation of integral Ito and Brownian motion*	motion dengan MATLAB *- Writing about solutions to some of the problems given* *- Paper implementation of Brownian motion with MATLAB*	menggunakan MATLAB *- Lecture* *- Responsiveness* *- Brownian motion implementation task to describe information flow and opportunities using MATLAB*		• *It is Integral* • *Brownian motion* ***[2]: Zawstaniak Chapter 7*** ***[3]: Shreve Chapter 3.4*** ***[1]: Syamsuddin Chapter 8,9***	
16	EVALUASI AKHIR SEMESTER *Final Semester Evaluation*						

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