MODULE HANDBOOK

RELIABILITY ANALYSIS

BACHELOR DEGREE PROGRAM

DEPARTMENT OF STATISTICS

FACULTY OF SCIENCE AND DATA ANALYTICS

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

ENDORSEMENT
PAGE

	MODULE HANDBOOK **RELIABILITY ANALYSIS** **DEPARTMENT OF STATISTICS** **INSTITUT TEKNOLOGI SEPULUH NOPEMBER**

Proses ***Process***	**Penanggung Jawab** ***Person in Charge***			**Tanggal** ***Date***
	Nama ***Name***	**Jabatan** ***Position***	**Tanda tangan** ***Signature***	
Perumus *Preparation*	Dr. Muhammad Mashuri, M.T.	Dosen *Lecturer*		**March 28, 2019**
Pemeriksa dan Pengendalian *Review and Control*	Dr. Muhammad Mashuri, M.T. Dr. Hidayatul Khusna, S.Si	Tim kurikulum *Curriculum team*		**April 15, 2019**
Persetujuan *Approval*	Dr. Wibawati, S.Si., M.Si	Koordinator RMK *Course Cluster Coordinator*		**July 17, 2019**
Penetapan *Determination*	Dr. Kartika Fithriasari, M.Si	Kepala Departemen *Head of Department*		**July 30, 2019**

MODULE HANDBOOK
RELIABILITY ANALYSIS

Module name	**Reliability Analysis**
Module level	Undergraduate
Code	KS184634
Course (if applicable)	Reliability Analysis
Semester	Sixth Semester (Genap)
Person responsible for the module	Dr. Muhammad Mashuri, M.T.
Lecturer	Dr. Muhammad Mashuri, M.T. Dr. Hidayatul Khusna, S.Si
Language	Bahasa Indonesia
Relation to curriculum	Undergraduate degree program, **elective**, 6th semester.
Type of teaching, contact hours	Lectures, <50 students
Workload	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3hours) per week. 3. 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 80% of the lectures to sit in the exams.

Mandatory prerequisites	• Mathematical Statistics I	
Learning outcomes and their corresponding to PLOs	CLO.1 Describes the concept of reliability to determine the reliability of a component or system CLO2. Able to explain reliability, maintainability and availability analysis procedures to determine the reliability of components or systems.	PLO.1
	CLO.3 Able to apply reliability models in the Industry to analyze data CLO.4 Able to identify, formulate, and solve statistical problems in the field of reliability analysis CLO.5. Able to use modern computing techniques and computer equipment needed to solve reliability optimization problems CPMK.6 Have knowledge of current and upcoming issues related to the field of reliability analysis	PLO.3
	CLO.7 Able to communicate effectively and work together in interdisciplinary and multidisciplinary teams CLO.8 Have professional responsibilities and ethics CLO.9 Able to motivate yourself to think creatively and learn throughout life	PLO.4
Content	Reliability is one of the courses in the industrial sector which has a field of study to determine the reliability of a tool. The purpose of studying reliability is to know the application of the Statistical method to determine the reliability and maintenance time of a tool and system, and to be able to perform reliability data analysis. The learning strategy used is discussion and practice as well as presentation assignments that come from scientific publications through journals, proceedings and others.	
Study and examination requirements and forms of examination	● In-class exercises ● Mid-term examination ● Final examination	

Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.
Reading list	1. Dhillon, B. S., 2006. *Maintainability, maintenance, and reliability for engineers*. CRC Press Taylor dan Francis Group. 2. Ebeling, C., 2010. *An Introduction to Reliability and Maintainability Engineering*. 2nd edition. Canada : Waveland Press, Inc.

RENCANA PEMBELAJARAN SEMESTER (RPS)

SEMESTER LEARNING PLAN

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	Mata Kuliah	Analisis Reliabilitas
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	MK Prasyarat	Statistika Matematika
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Bahan Kajian *Study Materials*	Dasar Sains, Teori Statistika, Pengumpulan Data, Deskripsi dan Eksplorasi, Komputasi dan Data Processing, Pemodelan, Industri dan Bisnis *Basic Science, Statistical Theory, Data Collection, Description and Exploration, Computing and Data Processing, Modeling, Industry and Business*
CPL yang dibebankan MK/ *PLO*	CPL-1 Mampu menerapkan pengetahuan teori statistika, matematika, dan komputasi CPL-3 Mampu menganalisis data dengan metode statistika yang tepat dan mengintepretasikannya CPL-4 Mampu mengindentifikasi,memformulasi, dan menyelesaikan masalah statistika di berbagai bidang terapan *PLO.1 Able to apply knowledge of statistical theory, mathematics, and computation* *PLO.3 Able to analyze data with appropriate statistical methods and interpret them* *PLO.4 Able to identify, formulate, and solve statistical problems in various applied fields*

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CP-MK *CLO*	CPMK.1 Menjelaskan konsep reliabilitas untuk menentukan kehandalan komponen atau sistem CPMK.2 Mampu menjelaskan prosedur analisis reliabilitas, maintainabilitas dan availabilitas untuk menentukan kehandalan komponen atau sistem. CPMK.3 Mampu mengaplikasikan model reliabilitas dalam Industri untuk menganalisis data CPMK.4 Mampu mengindentifikasi,memformulasi, dan menyelesaikan masalah statistika di bidang analisis reliabilitas CPMK.5 Mampu menggunakan teknik komputasi dan perangkat komputer modern yang diperlukan untuk menyelesaikan masalah optimasi reliabilitas CPMK.6 Memiliki pengetahuan tentang isu terkini dan mendatang yang berkaitan dengan bidang analisis reliabilitas CPMK.7 Mampu berkomunikasi secara efektif dan bekerjasama dalam tim yang interdisiplin dan multidisiplin CPMK.8 Memiliki tanggung jawab dan etika profesi CPMK.9 Mampu memotivasi diri untuk berpikir kreatif dan belajar sepanjang hayat *CLO.1 Describes the concept of reliability to determine the reliability of a component or system* *CLO2.2 Able to explain reliability, maintainability and availability analysis procedures to determine the reliability of components or systems.* *CLO.3 Able to apply reliability models in the Industry to analyze data*

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	CLO.4 Able to identify, formulate, and solve statistical problems in the field of reliability analysis *CLO.5. Able to use modern computing techniques and computer equipment needed to solve reliability optimization problems* *CPMK.6 Have knowledge of current and upcoming issues related to the field of reliability analysis* *CLO.7 Able to communicate effectively and work together in interdisciplinary and multidisciplinary teams* *CLO.8 Have professional responsibilities and ethics* *CLO.9 Able to motivate yourself to think creatively and learn throughout life*

Pertemuan *Meeting*	**Kemampuan Akhir Sub CP-MK** *Final Ability*	**Keluasan (materi pembelajaran)** *Extent (learning material)*	**Metode Pembelajaran** *Learning methods*	**Estimasi Waktu** *Duration*	**Bentuk Evaluasi** *Evaluation Type*	**Kriteria dan Indikator Penilaian** *Assessment Criteria and Indicators*	**Bobot Penilaian** *Scoring*

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1	1a. Memahami apa yang akan dipelajari dalam keseluruhan kuliah 1b. Memahami Konsep dasar analisis reliabilitas 1c. Memahami konsep distribusi waktu kegagalan *1a. Understand what will be*	● Konsep reliabilitas (reliability, Maintainability, availability). ● Distribusi waktu kegagalan (Failure distribution): fungsi reliability, Mean Time to Failure (MTTF), hazard rate function, Bathtub Curve, reliability bersyarat). ● CPMK.1 dan CPMK.2 • *The concept of reliability (reliability,*	Ceramah interaktif Diskusi (CID) *Interactive lecture Discussion (CID)*	150 menit *150 minutes*	Tes Observasi Aktifitas di kelas *Task Classroom Activity Observation*	1. Dapat memahami konsep-konsep dasar analisis reliablitas. 2. Dapat memahami konsep Distribusi waktu kegagalan (Failure distribution): fungsi reliability, Mean Time to Failure (MTTF), hazard rate function, Bathtub Curve, reliability bersyarat). *1. Can understand the basic concepts of reliability analysis.* *2. Can understand the concept of Failure distribution: reliability function, Mean Time*	10%/10%

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	studied in the entire lecture *1b. Understand the basic concepts of reliability analysis* *1c. Understand the concept of failure time distribution*	*Maintainability, availability).* • *Failure distribution: reliability function, Mean Time to Failure (MTTF), hazard rate function, bathtub curve, conditional reliability).* • *CLO.1 and CLO. 2*				*to Failure (MTTF), hazard rate function, bathtub curve, conditional reliability).*	

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2	2. Memahami konsep Model laju kegagalan konstan. *2.Understand the concept of constant failure rate model.*	Model laju kegagalan konstan (Fungsi reliability eksponensial, model-model kegagalan (failure modes), distribusi eksponensial dua parameter, proses poisson, redudansi dan CFR model). CPMK.1 dan CPMK.2 *Constant failure rate models (exponential reliability function, failure modes, two-parameter exponential distribution, Poisson*	Ceramah Interaktif, Diskusi, Active Learning (AL) *Interactive lecture Discussion (CID) Active Learning (AL)*	150 menit *150 minutes*	Tes Tugas 1 Observasi Aktifitas di kelas *Task Assignment 1 Classroom Activity Observation*	Memahami Model laju kegagalan konstan (Fungsi reliability eksponensial, model-model kegagalan (failure modes), distribusi eksponen sial dua parameter, proses poisson, redudansi dan CFR model). *Understand constant failure rate models (exponential reliability function, failure modes, two-parameter exponential distribution, Poisson process, redundancy and CFR model).*	10%/20%

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		process, redundancy and CFR model). CLO.1 and CLO. 2					

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3,4	3. Memahami konsep Time-dependent failure models. *3.Understand the concept of time-dependent failure model*	Time-dependent failure models (Distribusi Weibull, Distribusi Normal, Distribusi Log Normal, Distribusi Gamma). CPMK.1 dan CPMK.2 *Time-dependent failure models (Weibull distribution, Normal distribution, Log Normal distribution, Gamma distribution).* *CLO.1 and CLO. 2*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	300 menit *300 minutes*	Tes Observasi Aktifitas di kelas *Task Classroom Activity Observation*	Dapat menentukan parameter-parameter reliabilitas untuk Time-dependent failure models (Weibull, lognormal , Gamma). *Can determine reliability parameters for time-dependent failure models (Weibull, lognormal, Gamma).*	10%/30%

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5,6	4. Memahami konsep reliabilitas suatu system. *4. Understand the concept of system reliability.*	Reliability suatu sitem (Sistem Seri, arallel, kombinasi seri-paralel). CPMK.1 dan CPMK.2 *Reliability a system (Series system, parallel, series-parallel combination). CLO.1 and CLO. 2*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	300 menit *300 minutes*	Tes Observasi Aktifitas di kelas *Task Classroom Activity Observation*	Dapat menentukan ukuran-ukuran reliabilitas suatu sistem. *Can determine the reliability measures of a system.*	10%/40%

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7	5. Memahami konsep Model Markov untuk reabilitas sistem yang dependent. *5. Understand the concept of the Markov Model for dependent system reliability.*	State-dependent system. *State-dependent system.*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	150 menit *150 minutes*	TOA *TOA*	Dapat menentukan ukuran-ukuran reliabilitas suatu State-dependent system dengan analisis Markov. *Can determine the reliability measures of a State-dependent system with Markov analysis.*	10%/50%
8	**ETS**						

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9	6. Memahami konsep Maintainability. *6.Understand the concept of Maintainability.*	● Analisis downtime, distribusi waktu perbaikan, proses renewal, proses perbaikan minimal, waktu perbaikan system, reliabilitas pada preventive maintanence, state-dependent system with repair. ● Design for Maintainability *• Analysis of downtime, distribution of repair time, renewal process, minimal repair process, system*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	150 menit *150 minutes*	TOA *TOA*	1. Dapat mengkarakterisasi dan mengkuatifikasi perbaikan (repair) suatu item yang gagal. 2. Dapat mengaplikasikan Maintainability untuk proses desain. *1. Can characterize and quantify the repair (repair) of a failed item.* *2. Can apply Maintainability to the design process.*	10%/60%

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		repair time, reliability in preventive maintenance, state-dependent system with repair. • *Design for Maintainability.*					

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10	7. Memahami konsep Availability. *7. Understand the concept of Availability.*	Konsep dan definisi Availability, model availability eksponensial, availability sitem, inspeksi dan repair model availability. CPMK.1 dan CPMK.2 *The concept and definition of Availability, exponential availability model, system availability, inspection and repair availability model. CLO.1 and CLO. 2*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	150 menit *150 minutes*	TOA *TOA*	Dapat menentukan ukuran *performance system* dengan *Availability*. *Can determine the size of the performance system with Availability.*	10%/70%

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11	8. Memahami konsep Availability. *8. Understand the concept of Availability.*	Model-model perawatan pemeriksaan: ● Model Perawatan Pemeriksaan yang Memaksimumkan Availabilitas ● Model Perawatan Pemeriksaan yang Meminimumkan Total Ongkos Perawatan. CPMK.1 dan CPMK.2 *Examination maintenance models:* *• Examination Maintenance Models that Maximize Availability*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	150 menit *150 minutes*	TOA Tugas 2 *TOA* *Assignment 2*	Dapat menentukan perawatan. *Can determine treatment.*	15%/85%

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		• *Examination Care Model that Minimizes the Total Cost of Maintenance.* *CPMK.1 and CPMK. 2*					

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12-15	9. Memahami konsep-konsep Analisis data kegagalan. *9. Understand the concepts of failure data analysis.*	Analisis data kegagalan (Pengumpulan data: lengkap dan tersensor, Reliability testing , Reliability Growth testing, Identifikasi distribusi kegagalan dan Repair, statistical testing). CPMK.1 dan CPMK.2 *Failure data analysis (Data collection: complete and censored, Reliability testing, Reliability Growth testing, identification of failure distribution*	Ceramah Interaktif, Diskusi, dan Latihan Soal *Interactive Lectures, Discussions, and Exercises*	450 menit *450 minutes*	TOA *TOA*	Dapat menentukan menguji dan menentukan ukuran reliabilitas untuk data lengkap dan tersensor, non parametrik maupun parametrik. *Can determine test and determine reliability measures for complete and censored data, non-parametric and parametric.*	15%/100%

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		and repair, statistical testing). *CLO.1 and CLO. 2*					
16	**EAS**						

PUSTAKA/ REFERENCES:

1. Ebeling, C. (2010). An Introduction to Reliability and Maintainability Engineering.Second Edition, Waveland Press, Inc., Canada
1. Dhillon, B. S. (2006), Maintainability, maintenance, and reliability for engineers, CRC Press Taylor & Francis Group