

Module Handbook

Fundamentals of Intelligent Systems



Bachelor Degree Program Department of Biomedical Engineering

Faculty of Intelligent Electrical Technology and Informatics
Institut Teknologi Sepuluh Nopember

MODULE HANDBOOK

FUNDAMENTALS OF INTELLIGENT SYSTEMS

Module name	Fundamentals of Intelligent Systems	
Module level	Undergraduate	
Code	EB184603	
Course (if applicable)	Fundamentals of Intelligent Systems	
Semester	Second Semester (Genap)	
Person responsible for the module	Fauzan Arrofiqi, S.T., M.T., Ph.D.	
Lecturer	Achmad Arifin, S.T., M.Eng., Ph.D. Fauzan Arrofiqi, S.T., M.T., Ph.D.	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, enrichment , 6 th semester.	
Type of teaching, contact hours	Lectures, <60 students	
Workload	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) 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 75% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module, CLO 1: Students have ability to explain principles and algorithms of artificial neural network (ANN), CLO 2: Students have ability to develop computer program in realizing an ANN-based intelligent system. CLO 3: Students have ability to explain the mechanisms of all subsystems in fuzzy system. CLO 4: Student have ability to in realizing fuzzy system for data clustering and control applications.	PLO-05 PLO-06 PLO-06 PLO-06

	CLO 5: Students are able to design evolutionary algorithm, genetic programming. CLO 6: Students are able to design and implement intelligent electronic system applications.	PLO-08 PLO-02
Content	The Fundamentals of Intelligent Systems course is a compulsory subject which discusses the basic concepts of artificial intelligence and its development from conventional artificial intelligence to genetic algorithms. This course aims to make students understand the basic principles of the components in intelligent systems and be able to design intelligent electronic systems. The intelligent system design is expected to be able to be applied in the Biomedical Engineering discipline.	
Study and examination requirements and forms of examination	• In-class exercises • Written assignment 1, 2 • Demo and report 1,2,3,4,5 • Mid-term examination • Final examination	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	
Reading list	1. Fredric M Ham, Ivica Kostanic, Principles of Neurocomputing for Science & Engineering, McGraw-Hill Inc., 2001 2. JSR Jang, CT Tsun, E. Mizutani, Neuro-Fuzzy and Soft Computing, Prentice Hall Inc., 1997. 3. NK Bose and P. Liang, Neural Network Fundamental, McGraw Hill, 1996. 4. David B Fogel, Evolutionary Computation, IEEE Press. 5. Hua Li, M Gupta (Eds), Fuzzy Logic and Intelligent Systems, Kluwer AcPress, 1995.	

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) <i>COURSE</i>	KODE <i>CODE</i>	Rumpun MK <i>Course Cluster</i>	BOBOT (sks) <i>Credits</i>		SEMESTER	Tgl Penyusunan <i>Compilation Date</i>
Dasar Sistem Cerdas Fundamentals of Intelligent Systems	EW184603	Ilmu Dasar Teknik Basic Engineering	T=3	P=0	IV	
OTORISASI / PENGESAHAN <i>AUTHORIZATION/ENDORSEMENT</i>	Dosen Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ka DEPARTEMEN <i>Head of Department</i>	
	Fauzan Arrofiqi, S.T., M.T., Ph.D.		(Ir. Josaphat Pramudijanto, M.Eng.)		(Dr. Achmad Arifin, S.T., M.Eng.)	
Capaian Pembelajaran <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to the Course</i>					
	CPL-02 PLO-02	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 <i>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.</i>				

	CPL-05 PLO-05	Mampu menemukan, memahami, menjelaskan, merumuskan, dan menyelesaikan permasalahan umum pada bidang Teknik dan permasalahan khusus pada bidang Teknik Biomedika yang meliputi instrumentasi biomedika cerdas, teknik rehabilitasi medika, pencitraan dan pengolahan citra medika, serta informatika medika <i>Able to find, understand, explain, formulate, and solve general problems in the field of Engineering and special problems in the field of Biomedical Engineering which includes intelligent biomedical instrumentation, medical rehabilitation techniques, imaging and processing of medical images, and medical informatics</i>
	CPL-06 PLO-06	Mampu merancang dan melaksanakan eksperimen laboratorium dan/atau lapangan, menganalisa dan menginterpretasi data, serta menggunakan penilaian yang obyektif untuk menarik kesimpulan <i>Able to design and implement laboratory experiment and / or field experiments, analyze and interpret data, and use objective assessments to draw conclusions</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) - If CLO as description capability of each Learning Stage in the course, then CLO = LLO	
	CP MK 1 CLO 1	Mahasiswa mampu menjelaskan prinsip-prinsip dan algoritma artificial neural network (ANN) <i>Students have ability to explain principles and algorithms of artificial neural network (ANN),</i>
	CP MK 2 CLO 2	Mahasiswa mampu untuk mengembangkan program komputer untuk merealisasikan sistem cerdas berbasis neural network <i>Students have ability to develop computer program in realizing an ANN-based intelligent system.</i>
	CP MK 3 CLO 3	Mahasiswa mampu untuk menjelaskan mekanisme dari semua subsistem dalam sistem fuzzy <i>Students have ability to explain the mechanisms of all subsystems in fuzzy system</i>
	CP MK 4 CLO 4	Mahasiswa mampu merealisasikan sistem fuzzy untuk aplikasi data clustering dan sistem kontrol. <i>Student have ability to in realizing fuzzy system for data clustering and control applications.</i>
	CP MK 5 CLO 5	Mahasiswa mampu merancang evolutionary algorithm, genetic programming <i>Students are able to design evolutionary algorithm, genetic programming</i>
	CP MK 6	Mahasiswa mampu merancang dan mengimplementasikan aplikasi sistem elektronika cerdas

	CLO 6	<i>Students are able to design and implement intelligent electronic system applications</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 <i>CLO 1 / LLO 1</i>					√							
	CPMK 2 / SUB CPMK 2 <i>CLO 2 / LLO 2</i>						√						
	CPMK 3 / SUB CPMK 3 <i>CLO 3 / LLO 3</i>						√						
	CPMK 4 / SUB CPMK 4 <i>CLO 4 / LLO 4</i>						√						
	CPMK 5 / SUB CPMK 5 <i>CLO 5 / LLO 5</i>								√				
	CPMK 6 / SUB CPMK 6 <i>CLO 6 / LLO 6</i>		√										
Deskripsi Singkat MK Short Description of Course	Mata kuliah Dasar Sistem Cerdas merupakan mata kuliah wajib yang membahas konsep dasar kecerdasan buatan dan perkembangannya mulai dari conventional artificial intelligence hingga algoritma genetik. Mata kuliah ini bertujuan agar mahasiswa memahami tentang prinsip-prinsip dasar dari komponen-komponen dalam sistem cerdas dan mampu mendesain sistem elektronika cerdas. Desain sistem cerdas diharapkan mampu diterapkan dalam disiplin ilmu Teknik Biomedik. <i>The Fundamentals of Intelligent Systems course is a compulsory subject which discusses the basic concepts of artificial intelligence and its development from conventional artificial intelligence to genetic algorithms. This course aims to make students understand the basic principles of the components in intelligent systems and be able to design intelligent electronic systems. The intelligent system design is expected to be able to be applied in the Biomedical Engineering discipline.</i>												
Bahan Kajian: Materi pembelajaran Course Materials:	1. Dasar-dasar neuroscience dan pemodelan neuron / <i>Basics of neuroscience and neuron modeling</i> 2. Model neural network feedforward dan feedback / <i>Feedforward and feedback neural network models</i> 3. Metode pembelajaran neural network, competitive network : supervised, unsupervised / <i>Neural network learning methods, competitive network: supervised, unsupervised</i> 4. Sistem logika fuzzy, fuzzy inference system, fuzzy clustering & control / <i>Fuzzy logic system, fuzzy inference system, fuzzy clustering & control</i>												

		5. Algoritma evolusioner, pemrograman genetic / <i>Evolutionary algorithms, genetic programming</i>					
Pustaka <i>References</i>		Utama / Main: 1. Fredric M Ham, Ivica Kostanic, Principles of Neurocomputing for Science & Engineering, McGraw-Hill Inc., 2001 2. JSR Jang, CT Tsun, E. Mizutani, Neuro-Fuzzy and Soft Computing, Prentice Hall Inc., 1997. 3. NK Bose and P. Liang, Neural Network Fundamental, McGraw Hill, 1996. 4. David B Fogel, Evolutionary Computation, IEEE Press. 5. Hua Li, M Gupta (Eds), Fuzzy Logic and Intelligent Systems, Kluwer AcPress, 1995.					
Dosen Pengampu <i>Lectures</i>		Dr. Achmad Arifin, S.T., M.Eng. Fauzan Arrofiqi, S.T., M.T., Ph.D.					
Matakuliah syarat <i>Prerequisites</i>		-					
Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / <i>Final ability of each learning stage (LLO)</i>	Penilaian / <i>Assessment</i>		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [<i>Estimasi Waktu</i>] / <i>Form of Learning; Learning Method; Student Assignment;</i> [<i>Estimated Time</i>]		Materi Pembelajaran [<i>Pustaka</i>] / <i>Learning Material</i> [<i>Reference</i>]	Bobot Penilaian / <i>Assessment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Teknik / <i>Criteria & Techniques</i>	Tatap Muka / <i>In-class (5)</i>	Daring / <i>Online (6)</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)
1,2	Mahasiswa mampu menjelaskan prinsip-prinsip dan alogritma artificial neural network (ANN) <i>Students have ability to explain principles and</i>	• Kedalaman tingkat pemahaman • Ketepatan waktu pengumpulan tugas • Kebenaran mengerjakan tugas • Kebenaran jawaban dan penjabarannya	Tugas 1: Perancangan program simulasi gerbang XOR dan XNOR dengan beberapa input dengan metode NN McCulloh Pitts (Demo dan Laporan 1)	• Kuliah dan diskusi (2x) [TM : 3 x 50'] [BM : 3 x 60'] [PT : 3 x 60'] • <i>Lecture and discussion (2x)</i> [FF : 3 x 50'] [SA : 3 x 60']	• Belajar Mandiri – Daring atau Luring melalui Share ITS • Penugasan Terstruktur • <i>Independent Learning - Online</i>	Dasar-dasar neuroscience dan pemodelan neuron: • Conventional Artificial Intelligence • Konsep neuron secara anatomi dan fisiologi	5

	<i>algorithms of artificial neural network (ANN),</i>	• <i>The depth of understanding</i> • <i>Punctuality of assignment submission</i> • <i>Correctness of assignment work method</i> • <i>Correctness of the answer and its explanation</i>	<i>Assignment 1: Designing a simulation program for XOR and XNOR gates with multiple inputs using the NN McCulloh Pitts method (Demo and Report 1)</i>	<i>[SS : 3 x 60']</i>	<i>or Offline via Share ITS</i> • <i>Structured Assignments</i>	• <i>Sejarah pemodelan neuron</i> • <i>McCulloh Pitts</i> <i>Neuroscience basics and neuron modeling:</i> • <i>Conventional Artificial Intelligence</i> • <i>The concept of neurons in anatomy and physiology</i> • <i>History of neuron modeling</i> • <i>McCulloh Pitts</i>	
3,4,5	Mahasiswa mampu untuk mengembangkan program komputer untuk merealisasikan sistem cerdas berbasis neural network <i>Students have ability to develop computer program in realizing an ANN-based intelligent system.</i>	• Kedalaman tingkat pemahaman • Ketepatan menjelaskan pemahaman materi • Ketepatan waktu pengumpulan tugas • Kebenaran melaksanakan tugas • Keberhasilan menjelaskan tugas • Kebenaran jawaban dan analisis	• Tugas 2: Menurunkan persamaan delta error, update weight, dan threshold setiap layer pada suatu sistem (Tugas Tertulis 1) • Quiz 1 • Tugas 3: Program komputer dan analisis	• Kuliah dan diskusi (3x) [TM : 3 x 50'] [BM : 3 x 60'] [PT : 3 x 60'] • <i>Lecture and discussion (3x)</i> [FF : 3 x 50'] [SA : 3 x 60'] [SS : 3 x 60']	• Belajar Mandiri – Daring atau Luring melalui Share ITS • Penugasan Terstruktur • <i>Independent Learning - Online or Offline via Share ITS</i> • <i>Structured Assignments</i>	Klasifikasi neural network berdasarkan metode supervised learning: • Perceptron • Adaline (algoritma LMS) • Backpropagation <i>Neural network classification based on the supervised learning method:</i> • <i>Perceptron</i>	20

		• <i>The depth of understanding</i> • <i>Accuracy in explaining understanding of the material</i> • <i>Punctuality of assignment submission</i> • <i>Correctness of assignment work method</i> • <i>Success of explaining assignment</i> • <i>Correctness of answers and analysis</i>	pengenalan huruf menggunakan metode neural network supervised learning (Demo dan Laporan 2) • <i>Assignment 2: Deriving the delta error equation, weight update, and threshold for each layer in a system (Written Task 1)</i> • <i>Quiz I</i> • <i>Assignment 3: Computer program and letter recognition analysis using the neural network supervised learning method (Demo and Report 2)</i>			• <i>Adaline (LMS algorithm)</i> • <i>Backpropagation</i>	
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6,7	Mahasiswa mampu untuk menjelaskan mekanisme dari semua subsistem dalam sistem fuzzy <i>Students have ability to explain the mechanisms of all subsystems in fuzzy system</i>	• Ketepatan menjelaskan pemahaman materi • Ketepatan waktu pengumpulan tugas • Kebenaran melaksanakan tugas • Keberhasilan menjelaskan tugas • Accuracy in explaining understanding of the material • Punctuality of assignment submission • Correctness of assignment work method • Success of explaining assignment	• Tugas 4: Perancangan program komputer dan analisis self-organizing map (SOM) (Demo dan Laporan 3) • Assignment 4: Designing a computer program and analysis of the self-organizing map (SOM) (Demo and Report 3)	• Kuliah dan diskusi (2x) [TM : 3 x 50'] [BM : 3 x 60'] [PT : 3 x 60'] • Lecture and discussion (2x) [FF : 3 x 50'] [SA : 3 x 60'] [SS : 3 x 60']	• Belajar Mandiri – Daring atau Luring melalui Share ITS • Penugasan Terstruktur • Independent Learning - Online or Offline via Share ITS • Structured Assignments	Klasifikasi neural network berdasarkan metode unsupervised learning: • Self-organizing map (SOM) • Adaptive Resonant Theory (ART) Neural network classification based on the unsupervised learning method: • Self-organizing map (SOM) • Adaptive Resonant Theory (ART)	10
8	EVALUASI TENGAH SEMESTER MID-SEMESTER EXAM						15
9, 10, 11	Mahasiswa mampu merealisasikan sistem fuzzy untuk aplikasi data clustering dan sistem kontrol. <i>Student have ability to in realizing fuzzy system for data</i>	• Ketepatan waktu pengumpulan tugas • Kebenaran melaksanakan tugas • Keberhasilan menjelaskan tugas • Kebenaran jawaban dan penjabarannya	Tugas 5: Menyebutkan macam-macam bentuk dari membership function beserta dengan fungsi	• Kuliah dan diskusi (3x) [TM : 3 x 50'] [BM : 3 x 60'] [PT : 3 x 60'] • Lecture and discussion (3x)	• Belajar Mandiri – Daring atau Luring melalui Share ITS • Penugasan Terstruktur	Sistem Fuzzy: • Fuzzy sets • Fuzzy membership functions • Fuzzy inference system • Fuzzy classification	5

	clustering and control applications.	• Punctuality of assignment submission • Correctness of assignment work method • Success of explaining assignment • Correctness of answers and its explanation	matematisnya. (Tugas Tertulis 2) Assignment 5: Stating the various forms of membership functions along with their mathematical functions. (Written Assignment 2)	[FF : 3 x 50'] [SA : 3 x 60'] [SS : 3 x 60']	• Independent Learning - Online or Offline via Share ITS - Structured Assignments	Fuzzy System: • Fuzzy sets • Fuzzy membership functions • Fuzzy inference system • Fuzzy classification	
12, 13	Mahasiswa mampu merancang evolutionary algorithm, genetic programming. <i>Students are able to design evolutionary algorithm, genetic programming.</i>	• Kelengkapan dan kerapian hasil laporan • Ketepatan waktu pengumpulan tugas • Kebenaran menjelaskan program • Kebenaran jawaban dan analisis • Completeness and neatness of report • Punctuality of assignment submission • Correctness of explaining assignment • Correctness of answers and analysis	• Tugas 6: Perancangan software pemrograman genetik. (Demo dan Laporan 4) • Quiz 2 • Assignment 6: Designing genetic programming software. (Demo and Report 4) • Quiz 2	• Kuliah dan diskusi (2x) [TM : 3 x 50'] [BM : 3 x 60'] [PT : 3 x 60'] • Lecture and discussion (2x) [FF : 3 x 50'] [SA : 3 x 60'] [SS : 3 x 60']	• Belajar Mandiri – Daring atau Luring melalui Share ITS • Penugasan Terstruktur • Independent Learning - Online or Offline via Share ITS • Structured Assignments	Evolutionary algorithm: • Natural evolution, meliputi paradigma Neo-Darwinian, genotip dan fenotip Evolutionary algorithm: • Natural evolution, including the Neo-Darwinian paradigm, genotype and phenotype	15

14, 15	Mahasiswa mampu merancang dan mengimplementasikan aplikasi sistem elektronika cerdas. <i>Students are able to design and implement intelligent electronic system applications.</i>	• Ketepatan waktu pengumpulan tugas • Kebenaran melaksanakan tugas • Keberhasilan menjelaskan tugas • Kebenaran jawaban dan analisis • <i>Punctuality of assignment submission</i> • <i>Correctness of assignment work method</i> • <i>Correctness of explaining assignment</i> • <i>Correctness of answers and analysis</i>	Tugas 7: Perancangan program pendulum dengan kontrol PID menggunakan metode Fuzzy dan Neural Network. (Demo dan Laporan 5) <i>Assignment 7: Designing a pendulum program with PID control using Fuzzy and Neural Network methods. (Demo and Report 5)</i>	• Kuliah dan diskusi (2x) [TM : 3 x 50'] [BM : 3 x 60'] [PT : 3 x 60'] • <i>Lecture and discussion (2x)</i> [FF : 3 x 50'] [SA : 3 x 60'] [SS : 3 x 60']	• Belajar Mandiri – Daring atau Luring melalui Share ITS • Penugasan Terstruktur • <i>Independent Learning - Online or Offline via Share ITS</i> • <i>Structured Assignments</i>	Menerapkan metode pada sistem elektronika cerdas yang meliputi neural network, fuzzy, dan algoritma genetic dalam implementasi ilmu bidang teknik dan tau teknik biomedik. <i>Applying methods to intelligent electronic systems that include neural networks, fuzzy, and genetic algorithms in the implementation of engineering and / or biomedical engineering.</i>	15
16	EVALUASI AKHIR SEMESTER FINAL-SEMESTER EXAM						15

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 : Fundamentals of Intelligent Systems		RA&E
			Write Doc Code
Kode/code: EB184603	Bobot sks/credits (T/P): 3/0	Rumpun MK: Ilmu Dasar Teknik Course Cluster: Basic Engineering	Kode/code: EB184603
OTORISASI AUTHORIZATION	Penyusun RA & E <i>Compiler A&EP</i> Fauzan Arrofiqi, S.T., M.T., Ph.D.	Koordinator RMK Course Cluster Coordinator Ir. Josaphat Pramudijanto, M.Eng.	OTORISASI AUTHORIZATION Dr. Achmad Arifin, S.T., M.Eng.

Mg ke/ Week (1)	Sub CP-MK / <i>Lesson Learning Outcomes (LLO)</i> (2)	Bentuk Asesmen (Penilaian) <i>Form of Assessment</i> (3)	Bobot / Load (%) (4)
1-2	Sub CP-MK 1: Mahasiswa mampu memahami dasar-dasar neuroscience dan pemodelan neuron. LLO 1: <i>Students are able to understand the basics of neuroscience and neuron modeling.</i>	Non-Tes: Demo dan laporan 1: Perancangan program simulasi gerbang XOR dan XNOR dengan beberapa input dengan metode NN McCulloh Pitts. Tes: 1 Soal pada Quiz 1 1 Soal pada ETS Non-Test: Demo and report 1: Designing a simulation program for XOR and XNOR gates with multiple inputs using the NN McCulloh Pitts method. Test: 1 Question in Quiz 1 1 Question in Mid-Exam	12
3-5	Sub CP-MK 2: Mahasiswa mampu menjelaskan dan menganalisis model neural network dengan metode supervised learning. LLO 2:	Non-tes : Tugas tertulis 1: Menurunkan persamaan delta error, update weight, dan threshold setiap layer pada suatu sistem. Demo dan laporan 2: Program komputer dan analisis pengenalan huruf menggunakan metode neural network supervised learning. Tes :	23

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	<i>Students are able to explain and analyze neural network models with supervised learning method.</i>	2 Soal pada Quiz 1 1 Soal pada ETS Non Test: Written Assignment 1: <i>Deriving the delta error equation, weight update, and threshold for each layer in a system.</i> Demo and report 2: <i>Computer program and letter recognition analysis using the neural network supervised learning method.</i> Test: 2 Questions in Quiz 1 1 Question in Mid-Exam	
6-7	Sub CP-MK 3: Mahasiswa mampu menjelaskan dan menganalisis model neural network dengan metode unsupervised learning. LLO 3: <i>Students are able to explain and analyze the neural network model with unsupervised learning method.</i>	Non-tes: Demo dan laporan 3: Perancangan program komputer dan analisis self-organizing map (SOM). Tes : 1 Soal pada ETS Non-test: Demo and report 3: <i>Designing a computer program and analysis of the self-organizing map (SOM).</i> Test: 1 Question in Mid Exam	15
9-11	Sub CP-MK 4: Mahasiswa mampu menjelaskan dan menganalisa sistem logika fuzzy, fuzzy inference sistem, fuzzy clustering dan control. LLO 4: <i>Students are able to explain and analyze fuzzy logic systems, fuzzy inference systems, fuzzy clustering and control.</i>	Non-tes : Tugas tertulis 2: Menyebutkan macam-macam bentuk dari membership function beserta dengan fungsi matematisnya. Tes: 1 Soal pada Quiz 2 1 Soal pada EAS Non-Test: Written Assignment 2: <i>Stating the various forms of membership functions along with their mathematical functions.</i> Test: 1 Question in Quiz 2 1 Question in Final Exam	14
12-13	Sub CP-MK 5:	Non-tes:	16

Mg ke/ Week (1)	Sub CP-MK / Lesson Learning Outcomes (LLO) (2)	Bentuk Asesmen (Penilaian) Form of Assessment (3)	Bobot / Load (%) (4)
	Mahasiswa mampu merancang evolutionary algorithm, genetic programming. LLO 5: <i>Students are able to design evolutionary algorithm, genetic programming.</i>	Demo dan laporan 4: Perancangan software pemrograman genetik. Tes: 1 Soal pada Quiz 2 1 Soal pada EAS Non-test: Demo and report 4: <i>Designing genetic programming software.</i> Test: 1 Question in Quiz 2 1 Question in Final Exam	
11	Sub CP-MK 6: Mahasiswa mampu merancang dan mengimplementasikan aplikasi sistem elektronika cerdas. LLO 6: <i>Students are able to design and implement intelligent electronic system applications.</i>	Non-tes : Demo dan laporan 5: Perancangan program pendulum dengan kontrol PID menggunakan metode Fuzzy dan Neural Network. Tes: 1 Soal pada EAS Non-test: Demo and report 5: <i>Designing a pendulum program with PID control using Fuzzy and Neural Network methods.</i> Test: 1 Question in Final Exam	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 / PLO charged to the course	CPMK / Course Learning Outcome (CLO)	Minggu ke / Week	Bentuk Asesmen / Form of Assessment	Bobot / Load (%)
CPL-02 / PLO-02	CPMK 1 / CLO 1	Week 1-2	Demo and report 1	5
			1 Question in Quiz 1	2
			1 Question in Mid-Exam	5
CPL-03 / PLO-03	CPMK 2 / CLO 2	Week 3-5	Written assignment 1	5
			Demo and report 2	10
			2 Questions in Quiz 1	3
			1 Question in Mid Exam	5
	CPMK 3 / CLO 3	Week 6-7	Demo and report 3	10
			1 Question in Mid Exam	5
	CPMK 4 / CLO 4	Week 9-11	Written assignment 2	5
			1 Question in Quiz 2	4
			1 Question in Final Exam	5
CPL-05 / PLO-05	CPMK 5 / CLO 5	Week 12-13	Demo and report 4	10
			1 Question in Quiz 2	1
			1 Question in Final Exam	5
CPL-06 / PLO-06	CPMK 6 / CLO 6	Week 14-15	Demo and report 5	15
			1 Question in Final Exam	5
				$\Sigma = 100\%$

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		0.05			0.05	0.1		0					0.2

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
	Assignment 1													
2	Final Project 1 (Evaluasi Tengah Semester) Final Project 1 (Mid-term Exam)		0.1			0.05	0.15		0					0.3
3	Tugas 2 Assignment 2		0				0.1		0.05					0.15
4	Final Project 2 (Evaluasi Akhir Semester)		0.05				0.2		0.1					0.35

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
	Final Project 2 (Final Exam)													
	Total		0.2			0.1	0.55		0.15					1

