

Syllabus Curriculum 2023

TEKNIK

MASTER OF INFORMATICS PROGRAM (MIP) DEPARTMENT OF INFORMATICS FACULTY OF INTELLIGENCE ELECTRICAL AND INFORMATICS TECHNOLOGY INSTITUT TEKNOLOGI SEPULUH NOPEMBER 2023

TABLE OF CONTENT

Program Learning Outcomes	4
Course List of MIP	6
List of MIP Elective Courses	7
Computational Intelligence	8
Net-Centric Computing	. 12
Software Engineering	. 14
Matriculation-Object Oriented Programming	. 16
Matriculation-Python Programming	. 18
Advance Topics in Distributed Systems	. 20
Advance Topics in Digital Forensic	. 23
Advance Topics in Mobile Computing	. 25
Advance Topics in Cloud Computing	. 27
Advance Topics in Time Series Data Analysis	. 29
Advance Topics in Human and Computer Interaction	. 31
Advance Topics in Knowledge Based Engineering	. 33
Advance Topics in Information Technology Governance	. 35
Advance Topics in Geospatial Data Analysis	38
Advance Topics in Software Testing	40
Advance Topics in Data Mining	42
Advance Topics in Image Processing	45
Research Methodology	48
Advance Topics in Multimedia Networking	50
Advance Topics in Network Security	52
Advance Topics in Wireless Network	54
Advance Topics in Network Design and Audit	57
Advance Topics in Modelling and Simulation	59
Advance Topics in Multivariate Data Analysis	62
Advance Topics in Game Development, Virtual Reality, and Augmented Reality	64
Advance Topics in Computer Graphics	67
Advance Topics in System Audit	69

Advance Topics in Big Data	. 71
Advance Topics in Quantum Computing	. 73
Advance Topics in Software Evolution	. 76
Advance Topics in Software Project Management	. 78
Advance Topics in Requirement Engineering	. 81
Advance Topics in Software Quality Assurance	. 84
Advance Topics in Text Mining	. 86
Advance Topics in Computer Vision	. 88
Advance Topics in Biomedical Computing	. 90
Thesis - Proposal	. 94
Thesis - Scientific Publication	. 96
Thesis - Final Defense	. 98

PROGRAM LEARNING OUTCOMES MASTER OF INFORMATICS PROGRAM (MIP) INSTITUT TEKNOLOGI SEPULUH NOPEMBER

The Program Learning Outcomes (PLO) of the MIP:

PLO-1 Able to show attitudes and characters that reflect: piety to God Almighty, noble character, sensitivity, and concern about social and environmental issues, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and the broader community through innovation, creativity, and innovation, excellence, strong leadership, synergy with other potentials to achieve maximum results.

PLO-2 Able to develop and solve science and technology problems in the fields of artificial intelligence, network-based computing, software engineering, and information management through research with inter- or multidisciplinary approaches to produce innovative and tested works in the form of theses and papers that have been accepted in national scientific journals accredited or accepted at reputable international seminars.

- Able to manage their learning and develop themselves as lifelong learners to **PLO-3** compete at national and international levels to make a real contribution to solving problems by paying attention to the principle of sustainability.
- PLO-4 Able to improve logical, critical, systematic, and creative thinking through scientific research in the field of science and technology-based on scientific principles, procedures, and ethics in the form of theses and papers published in seminars or scientific journals at both national and international levels.
- Able to improve the concepts and principles of intelligent system and computational science to produce intelligent applications in various scientific fields and disciplines.
- PLO-6 Able to improve the concepts and principles of network architecture and networkbased computing to have high performance and security.
- PLO-7 Able to analyze and improve software quality both technically and managerial by using software engineering processes principles.
- PLO-8 Able to model and improve the principles of computer graphics as well as human and computer interactions in software development.

- **PLO-9** Able to analyze and improve computational problem solving through modeling with exact, numerical, and probabilistic approaches effectively and efficiently.
- PLO-10 Able to improve methods for managing data and information in various forms.

COURSE LIST OF MIP

No	Course Code	Course Name	Credit
1 st Semester			
1	EF235101	Computational Intelligence	3
2	EF235102	Net-Centric Computing	3
3	EF235103	Software Engineering	3
4	EF235191	Matriculation-Object Oriented Programming*	3
5	EF235192	Matriculation-Python Programming*	3
6	EF235XXX	1 st Elective Course	3
	•	Total Credits in 1 st Semester	12-15
		2 nd Semester	
1	EF235201	Research Methodology	3
2	EF235XXX	2 nd Elective Course	3
3	EF235XXX	3 rd Elective Course	3
4	EF235XXX	4 th Elective Course	3
Total Credits in 2 nd Semester		12	
3 rd Semester			
1	EF235301	Thesis - Proposal	3
2	EF235302	Thesis - Scientific Publication	3
Total Credits in 3 rd Semester		6	
4 th Semester			
1	EF235401	Thesis - Final Defense	6
Total Credits in 4th Semester6			6
		Total Credits for MIP	36-42

*) only required for students of the Recognition of Past Learning (RPL) program - Previous study programs are not aligned with MIP.

No	Course Code	Course Name	Credit
Odd Semester			
1	EF235112	Advance Topics in Distributed Systems	3
2	EF235113	Advance Topics in Digital Forensic	3
3	EF235115	Advance Topics in Mobile Computing	3
4	EF235116	Advance Topics in Cloud Computing	3
5	EF235122	Advance Topics in Time Series Data Analysis	3
6	EF235131	Advance Topics in Human and Computer Interaction	3
7	EF235142	Advance Topics in Knowledge Based Engineering	3
8	EF235143	Advance Topics in Information Technology Governance	3
9	EF235145	Advance Topics in Geospatial Data Analysis	3
10	EF235155	Advance Topics in Software Testing	3
11	EF235161	Advance Topics in Data Mining	3
12	EF235162	Advance Topics in Image Processing	3
	Tota	l Credits of Elective Courses in Odd Semester	36
		Even Semester	
1	EF235211	Advance Topics in Multimedia Networking	3
2	EF235214	Advance Topics in Network Security	3
3	EF235217	Advance Topics in Wireless Network	3
4	EF235218	Advance Topics in Network Design and Audit	3
5	EF235221	Advance Topics in Modelling and Simulation	3
6	EF235223	Advance Topics in Multivariate Data Analysis	3
7	EF235232	Advance Topics in Game Development, Virtual Reality, and Augmented Reality	3
8	EF235233	Advance Topics in Computer Graphics	3
9	EF235241	Advance Topics in System Audit	3
10	EF235244	Advance Topics in Big Data	3
11	EF235246	Advance Topics in Quantum Computing	3
12	EF235251	Advance Topics in Software Evolution	3
13	EF235252	Advance Topics in Software Project Management	3
14	EF235253	Advance Topics in Requirement Engineering	3
15	EF235254	Advance Topics in Software Quality Assurance	3
16	EF235263	Advance Topics in Text Mining	3
17	EF235264	Advance Topics in Computer Vision	3
18	EF235265	Advance Topics in Biomedical Computing	3
Total Credits of Elective Courses in Even Semester54			54
Total Credits of Elective Courses in MIP90			

LIST OF MIP ELECTIVE COURSES

Module designation	Computational Intelligence
Course Code	EF235101
Semester(s) in which the	1 st
module is taught	
A Person responsible for the	Prof. Dr.Eng. Nanik Suciati, S.Kom., M.Kom.
module	
Language	Indonesian
Relation to curriculum	Compulsory
Teaching methods	Lecture, discussion, case method, discovery learning, project-
	based learning
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$
self-study hours)	per week.
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 180 \text{ minutes} (3)$
	hours) per week.
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.
Credit points	3 credit points (SKS)
Required and recommended	-
prerequisites for joining the	
module	
Course Description	Students learn about several types of input data, Fourier and
	Wavelet transforms, a comprehensive understanding of the
	classification method with supervised and unsupervised
	learning, and methods of optimization with evolutionary
	algorithms, as well as the reduction and transformation of data.
	Students implement these methods to a case study in the form
	of project tasks, starting from data input, processing and data
	extraction, data reduction, optimization, and classification by
	applying the supervised and unsupervised learning, and write
	papers of the modeling results. Supervised learning includes
	the multilayer perceptron, RBF, ANFIS, SVM, and the soft
	SVM. Unsupervised learning covers a variety of clustering
	methods. Optimization methods cover evolutionary algorithms such as Capacita Algorithm (CA) . As $Calarry (ACO)$. But interval
	Swarm Ontimization (DSO) Artificial Das Colony, Badyation
	and transformation of data includes Dringing Component
	Analysis (PCA) Linear Discriminant Analysis (LDA) and
	Independent Component Analysis (ICA), and
	independent Component Analysis (ICA).

Module objectives/intended	Students are able to analyze the application of	
learning outcomes	machine learning concepts to various types of	PLO 2
	applications.	
	Students are able to analyze and develop	PLO 3,
	clustering techniques.	PLO 5
	Students are able to analyze and develop	
	classification techniques based on distance,	$\frac{1103}{105}$
	probability and rules.	TLO 5
	Students are able to analyze and develop	PLO 3
	discriminant function-based classification	PLO 5
	techniques.	1205
	Students are able to analyze and develop	PLO 3,
	reinforcement learning techniques.	PLO 5
	Students are able to analyze and develop	
	optimization techniques and combine them with	PLO 2
	clustering and/or classification techniques to	PLO 3
	solve real problems and publish the results of	PLO 5
	their research in seminars or journals at national	1200
	and international levels.	
Content	1. Data Input: available dataset, static data, d	ynamic data,
	machine perception, model illustration const	isting of pre-
	processing, feature extraction, classification.	
	2. Bayesian classification: a review of the conc	cept of Bayes
	decision theory and discriminant functions,	discriminant
	functions for normal density and discuss the	applications
	that use Bayesian classification.	
	3. Data Transformation: Discrete Fourier Tra	nsform, Fast
	Fourier Transform (FFT), Discrete Tir	ne Wavelet
	I ransform.	
	4. Clustering: Hard clustering, vector quantiz	history
	clustering, kernel clustering methods,	nierarchical
	5 Eugra Logic Amprovimente Recommende a	avious of the
	3. Fuzzy Logic, Approximate Reasoning: a R	eview of the
	multiple rules. Mamdani implication function	
	6 Linear and ponlinear classifiers: multilover	r nercentron
	Radial Basis Function ANFIS SVM A	ecision tree
	combination classifiers	
	7. Implementation of clustering method and neu	ral networks

	8. Evolutionary Algorithm: a review of the concept of		
	Genetic Algorithm (GA), Ant Colony Optimization		
	(ACO), Particle Swarm Optimization (PSO), Artificial Bee		
	Colony (ABC).		
	9. Dimensional reduction and data transformation: review the		
	concept of Principle Component Analysis (PCA), Linear		
	Discriminant Analysis (LDA), Independent Component		
	Analysis (ICA), and application examples.		
	10. Implementation of classifiers combined with optimization		
	methods or with PCA and LDA, and analysis of the related		
	research.		
	11. Implementation of feature vector extraction and		
	classification in a group project, and analysis the related		
	research.		
	12. Writing reports and papers on the implementation of		
	classification models.		
Exams and assessment	Assignments, paper review, and final project presentation		
formats			
Study and examination	The final grade is drawn from the following components:		
requirements	• 1 st assignments (Clustering and classification using python		
	programming): 25% of grade		
	• Paper review (International journal): 25% of grade		
	• Final project presentation: 20% of grade		
	• 2 nd assignments (Simple programming: reinforcement		
	learning, discriminant classification): 30% of grade		
	Students must have a final grade of 61% or higher to pass this		
	course.		
Reading list	1. Stuart Russel, Peter Norvig, Artificial Intelligence: A		
	Modern Approach, Fourth edition, Pearson, 2020		
	2. Christopher Bishop, Pattern Recognition and Machine		
	Learning. Springer, 2006		
	3. Andries P. Engelbrecht, Computational Intelligence An		
	Introduction, Second Edition, John Wiley & Sons Ltd,		
	2007		
	4. Rudolf Kruse, Christian Borgelt, Frank Klawonn,		
	Christian Moewes, Matthias Steinbrecher, Pascal Held,		
	Computational Intelligence: A Methodological		
	Introduction, Springer, 2013		

5.	Michael Negnevitsky, Artificial Intelligence: A Guide to
	Intelligent Systems, Second Edition, Addison Wesley,
	2002
6.	Arthur K. Kordon, Applying Computational Intelligence,
	Springer-Verlag Berlin Heidelberg 2010
7.	S. Sumathi, Surekha P., Computational Intelligence
	Paradigms: Theory and Applications using MATLAB,
	CRC Press, 2010
8.	Peter Harrington, Machine Learning in Action, Manning,
	2012
9.	Scientific articles related to Computational Intelligence in
	reputable international journals.

Module designation	Net-Centric Computing	
Course Code	EF235102	
Semester(s) in which the	1 st	
module is taught		
A Person responsible for the	Ir. Ary Mazharuddin Shiddiqi, S.Kom., M.Comp.	Sc., Ph.D.
module		
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, discussion, discovery learning, project-ba	ased learning
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Network-Based Computing course provide knowledge of	
	the unique characteristics that exist in mobil	le networks.
	Students are guided to be able to define problems	that arise in
	mobile networks and are asked to design the	right routing
	protocol to solve problems on mobile networks wh	hich can then
	be developed to improve performance.	
Module objectives/intended	Students are able to explain and assemble	PLO 1.
learning outcomes	knowledge in the field of Network-Based	PLO 2.
	Computing in terms of concepts, theories, and	PLO 3.
	terms in various kinds of supporting	PLO 6
	technologies.	
	Students are able to provide a critical assessment	PLO 1,
	of a problem in the supporting technology of	PLO 2,
	Network-Based Computing.	PLO 3,
		PLO 6
	Students are able to analyze and assess the	PLO 1,
	supporting technology of Network-Based	PLO 2,
	Computing to be applied in new or different	PLO 3,
	tields.	PLO 6

	Students are able to plan or find a solution	PLO 1,
	scientifically to solve problems in the field of	PLO 2,
	supporting technology for Network-Based	PLO 3,
	Computing.	PLO 6
Content	1. Data transmission	
	2. Data link concepts	
	3. Networking concepts	
	4. Network security	
	5. Application protocols	
	6. Net-centric computing and web programm	ing
Exams and assessment	Assignments, quizzes, midterm assessment, and fi	inal project
formats		
Study and examination	The final grade is drawn from the following comp	oonents:
requirements	• Assignments: 25% of grade	
	• Quiz: 15% of grade	
	• Midterm assessment: 25% of grade	
	• Final project: 35% of grade	
	Students must have a final grade of 61% or higher	to pass this
	course.	
Reading list	1. Pei Zheng, Larry L. Peterson, Bruce S. D	avie, Adrian
	Farrel, Wireless Networking Complete, 20	009, Morgan
	Kaufmann	
	2. Abdessalam Helal, Et.Al," Anytime,	Anywhere
	Computing, Mobile Computing Com	cepts and
	Technology", McGraw-Hill	
	3. Mobile Computing Principles Designing And	l Developing
	Mobile Applications With Uml And Xr	nl and the
	Environment", Oxford Publisher 2002.	
	4. Location Management and Routing in Mob	oile Wireless
	Networks, Amitava Mukherjee,	Somprakash
	Bandyopadhyay, Debashis Saha, Artech Hous	se Publisher
	5. Andreas Heinemann, Max Muhlhauser",	Peer-to-Peer
	Systems and Application	
	6. Mohammad Ilyas and Imad Mahgoub, Mobil	e Computing
	Handbook, Auerbach Publication	
	7. IEEE Transaction of Mobile Computing, IEE	E
	8. Pervasive and Mobile Computing, Elsevier	

Module designation	Software Engineering	
Course Code	EF235103	
Semester(s) in which the	1 st	
module is taught		
A Person responsible for the	Prof. Daniel Oranova Siahaan, S.Kom., M.Sc., P	D.Eng.,
module	Dr. Ir. Umi Laili Yuhana, S.Kom., M.Sc.	
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, discussion	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hour})$	s 30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 13$	80 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Software Engineering course provide knowledge about	
	application theory in software design and deve	lopment with
	standard and scientific planning, requirements	engineering,
	design, implementation, testing, and launch	methods, to
	produce software products that meet various quality	ty parameters
	technically and managerially and are useful	in software
Madula abiastiwas/intended	development.	
Module objectives/intended	Students are able to explain and assemble	PLO 2,
learning outcomes	knowledge in the software engineering process	PLO 3,
	in terms of concepts, theories, and terms in	PLO 7
	Students are able to analyze and make a aritical	
	assessment of a problem in software design	$\frac{1}{2}$
	assessment of a problem in software design.	PLO 7
	Students are able to analyze and make a critical	$\frac{1207}{PLO2}$
	Students are able to analyze and make a critical	1 LO 2,
	assessment of a problem in software testing	PLO 3
	assessment of a problem in software testing.	PLO 3, PLO 7
	assessment of a problem in software testing.	PLO 3, PLO 7 PLO 2
	assessment of a problem in software testing. Students are able to analyze and conduct critical assessments of software risks.	PLO 3, PLO 7 PLO 2, PLO 3.

	Students are able to analyze and make a critical	PLO 2,
	assessment of software quality.	PLO 3,
		PLO 7
	Students are able to analyze and conduct critical	PLO 2,
	assessments of software maintenance.	PLO 3,
		PLO 7
Content	1. Basic concept of software engineering	
	2. Software project planning	
	3. Software analysis and design	
	4. System modeling	
	5. Software testing	
	6. Software risks	
	7. Software quality	
	8. Software maintenance	
Exams and assessment	Quizzes, presentation, paper review, and final ass	sessment
formats		
Study and examination	The final grade is drawn from the following comp	ponents:
requirements	• 1 st quiz (Software project planning): 10% of g	grade
	• 2 nd quiz (System design): 10% of grade	
	• Presentation of paper review: 20% of grade	
	• 3 rd quiz (Software testing strategy): 10% of g	rade
	• 4 th quiz (Software risk control): 10% of grade	2
	• 5 th quiz (Software technical metrics): 10% of	grade
	• Final assessment: 30% of grade	0
	Students must have a final grade of 61% or high	er to pass this
	course.	
Reading list	1. Pressman, R. S., Software Engineering: A	Practitioner's
	Approach, 8th Edition, McGraw-Hill, 2014.	
	2. Sommerville, I., Software Engineering (1)	0th Edition).
	Pearson: 2015	- ,,
	3. Kin, G, Debois, P., Willis, J., Humble, J., and	d Allspaw, J.,
	The DevOps Handbook: How to Create	World-Class
	Agility, Reliability, and Security in	Technology
	Organizations	2.
	4. IEEE Computer Society, SWEBOK v.3.0, IEE	EE, 2014
	5. Annual Conference: International	Requirements
	Engineering Conference, IEEE.	-

Module designation	Matriculation-Object Oriented Programming	
Course Code	EF235191	
Semester(s) in which the	1 st	
module is taught		
A Person responsible for the	Agus Budi Raharjo, S.Kom., M.Kom., Ph.D.	
module		
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, discovery learning, problem-based learning, small	
	group discussion, collaborative learning	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$	
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 180$	minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3)	hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Matriculation-Object Oriented Programmi	ng course
	introduces the concept of object-oriented progra	mming for
	students who already have structured or	procedural
	programming knowledge (mainly, C/C++ pr	ogramming
	and abject oriented programming techniques us	in a shipped
	and object-oriented programming techniques us	ing object-
Module objectives/intended	Students are able to explain object based	PLO 1
learning outcomes	programming concepts along with the features of	PLO 2
learning outcomes	object-oriented programming languages	$\frac{1102}{103}$
	Students are able to analyze problems using an	PLO 1
	object-oriented approach	PLO 2
		PLO 3
	Students are able to model problem solutions	PLO 1.
	using an object-oriented approach.	PLO 2,
		PLO 3
	Students are able to implement problem solutions	PLO 1,
	in the form of programs using object-oriented	PLO 2,
	language.	PLO 3

Content	1. Eclipse IDE for Java Programming
	2. Eclipse IDE: Debugging, Classes and Objects, Types,
	Various Conditions and Loops, Exercises
	3. Array, ArrayList & Scanner; Exception and I/O
	4. Javadoc, Testing & Objects, Interface
	5. Inheritance
	6. Collection & Generics
	7. Graphical User Interface (GUI), Event Handling & Inner
	Class
	8. Access control & polymorphism, GUI Programming &
	MVC design patterns
	9. Collections: Advanced & Immutability
Exams and assessment	Quizzes, midterm assessment, and final assessment
formats	
Study and examination	The final grade is drawn from the following components:
requirements	• 1 st quiz: 25% of grade
	• Midterm assessment: 25% of grade
	• 2 nd quiz: 50% of grade
	• Final assessment: 25% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Murach, J. and Urban, M. (2015) Murach's Beginning Java
	with Eclipse. Fresno, CA, USA: Mike Murach &
	Associates, Inc.
	2. Deitel, P. and Deitel, H. (2020) JavaTM-How to
	Program—Late Objects. Eleventh Edition. Global Edition.
	New Yok, USA: Pearson Education Limited.

Module designation	Matriculation-Python Programming	
Course Code	EF235192	
Semester(s) in which the	1 st	
module is taught		
A Person responsible for the	Shintami Chusnul Hidayati, S.Kom., M.Sc., Ph.D	
module		
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, discussion	
Workload (incl. contact hours,	1. Lectures: 3 SKS x $50 = 150$ minutes (2 hours	s 30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: 3 SKS x 60 = 18 hours) per week.	30 minutes (3
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	This course aims to study the basic concepts of p	orogramming
	and data structures with Python, as well as dat	a processing
	concepts by utilizing Python libraries.	
Module objectives/intended	Able to understand software development	
learning outcomes	methodologies (analysis, design, coding, testing,	PLO 2, PLO 3
	documentation) and apply these methodologies	PLO 3, PLO 7
	to a case study.	ILO /
	Able to translate designs into algorithms	PLO 2,
	correctly and structured	PLO 3,
	concerty and structured.	PLO 7
	Able to design structured programs in a modular	PLO 2
	manner with a top-down approach using	$\frac{1}{2} = \frac{1}{2} = \frac{1}$
	functions in Python language, and able to	$\frac{110}{2}$
	perform debugging and testing processes.	
	Able to design and implement problem solutions	PLO 2
	using an object-oriented approach in Python	$\frac{1202}{PLO3}$
	language, and able to perform debugging and	PLO 7
	testing processes.	1207

		PLO 2,
	Able to model and implement problem solutions	PLO 3,
	using libraries and special functions in Python.	PLO 7
Content	1. Introduction to Python	
	2. Data Types, Variables, Basic Input-Output O	perations,
	Basic Operators	
	3. Boolean values, conditional execution, loops, lists and list	
	processing, logical and bitwise operations	
	4. Functions, tuples, dictionary, and data-proces	sing
	5. Modules, packages, pip	
	6. Strings, string and list methods, exceptions	
	7. Object-oriented programming	
	8. Generators, iterators, dan closures in Python	
	9. Pandas library	
Exams and assessment	Presentations and case studies	
formats		
Study and examination	The final grade is drawn from following compone	ents:
requirements	• Presentation of 1 st case study: 20% of grade	
	• Presentation of 2 nd case study: 30% of grade	
	• Presentation of 3 rd case study: 30% of grade	
	• Presentation of 4 th case study: 20% of grade	
	Students must have a final grade of 61% or highe	r to pass this
	course.	
Reading list	1. McKinney, W. (2022). Python for Data An	alysis: Data
	Wrangling with Pandas, NumPy, and Ju	pyter. United
	States: O'Reilly. ISBN: 9781098104030.	
	2. Müller, A. C., Guido, S. (2016). Introduction	to Machine
	Learning with Python: A Guide for Data Scien	ntists. United
	States: O'Reilly Media. ISBN: 978144936989	€7.
	3. Bengfort, B., Bilbro, R., Ojeda, T. (2018). Ap	oplied Text
	Analysis with Python: Enabling Language-	Aware Data
	Products with Machine Learning. Taiwan: O'I	Reilly Media.
	ISBN: 9781491962992.	
	4. Hilpisch, Y. J. (2019). Python for Finance	: Mastering
	Data-driven Finance. Japan: O'Reilly Me	dia. ISBN:
	9781492024330.	

Module designation	Advance Topics in Distributed Systems	
Course Code	EF235112	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Royyana Muslim Ijtihadie, S.Kom., M.Kom., P	h.D.
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture	
Workload (incl. contact	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hour})$	s 30 minutes)
hours, self-study hours)	per week.	
	2. Exercises and Assignments: 3 SKS x $60 =$	180 minutes
	(3 hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Distributed Systems cou	rse discusses
	the characteristics of distributed systems, incl	luding issues
	and challenges in aspects of distributed systems	. This lecture
	also discusses the identification of research p	problems and
	contributions in distributed systems.	
Module objectives/intended	Students are able to explain the definition,	
learning outcomes	paradigm and characteristics of distributed	PLO 6
	systems, including also synthesizing based on	
	the characteristics of distributed systems.	
	Students are able to understand certain topics	
	in distributed systems and can produce	PLO 2,
	syntheses of certain topics in distributed	PLO 6
	systems.	
	Students are able to identify research problems	PLO 2,
	and carry out advanced elaboration on topics	PLO 6
	in distributed systems.	
	Students are able to identify research problems	PLO 2,
	and carry out advanced elaboration to	PLO 6
	contribute new knowledge.	- •

Content	1. Introduction to distributed systems: concepts, goals, and
	limitations.
	2. Inter-process communication: message passing, remote
	procedure calls, distributed objects, and naming.
	3. Distributed systems-based programming: UDP/TCP
	socket and the use of middleware.
	4 Indirect communication (publish-subscribe and tuple
	snace)
	5 Middleware for distributed systems (middleware for
	s. White water for distributed systems (initial water for
	publish-subscribe, map-reduce, peer to peer, and
	message queue).
	6. Concepts, standards, and middleware on multi-agent and
	mobile agent.
	7. Distributed file systems and examples of their
	application.
	8. Research topic in mobile computing, pervasive
	computing, ubiquitous computing, and cloud computing.
	9. The issue of research in distributed systems (load
	balancing, load estimation, load migration, and big data).
Exams and assessment	Presentation, write and submit scientific article in national
formats	journals
Study and examination	The final grade is drawn from following components:
requirements	• 1 st presentation (The formulation of topic to be
1	researched): 25% of grade
	• Writing a draft of scientific article: 25% of grade
	• 2 nd presentation (The progress of the research): 25%
	of grade
	• Submit paper in national journals: 25% of grade
	Students must have a final grade of 61% or higher to pass
	this course
Reading list	1 Distributed Systems an Algorithmic Approach Second
	Edition Sukumar Ghosh 2015 CRC Press
	2 Design Patterns for Cloud Native Applications Patterns
	in Practice Using ADIs Data Events and Streams
	In Flacult Using AF15, Data, EVents, and Streams,
	Kasun murasin and Sriskandarajan Sunoinayan, 2021 ,
	3. Distributed Systems Design, Jie Wu, CRC Press.
	4. Distributed Computing Principles, Algorithms, and
	Systems, Ajay D. Kshemkalyani, Mukesh Singhal,
	2008, Cambridge University Press.

5	Distributed Systems Concepts and Design Fifth Edition,	
	George Coulouris, Jean Dollimore, Tim Kindberg,	
	Gordon Blair, 2012, Pearson.	
6	IEEE Transaction on Parallel and Distributed Systems,	
	IEEE	
7	Distributed Computing, Springer	
8	Communication of the ACM, ACM	

Module designation	Advance Topics in Digital Forensic	
Course Code	EF235113	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Hudan Studiawan, S.Kom., M.Kom., Ph.D.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, discovery learning, project-ba	ased learning
Workload (incl. contact hours,	1. Lectures: 3 SKS x $50 = 150$ minutes (2 hours 30 minutes)	
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topic in Digital Forensics is an interdisciplinary	
	course that uses various techniques to investigate	and analyze
	digital evidence. Digital forensics is a highly spec	cialized field
	for uncovering digital evidence from mob	ile devices,
	computers, and other digital storage devices.	This course
	covers topics such as forensic techniques and	tools, from
	obtaining evidence to digital evidence analysis. Th	e course also
	covers the latest research in digital forensics, allow	ving students
	to gain research experience in this field.	
Module objectives/intended	Students are able to explain and assemble	PLO 2,
learning outcomes	knowledge in the field of digital forensic	PLO 4,
	methodology.	PLO 5,
		PLO 6
	Students are able to provide a critical assessment	PLO 4,
	of a problem in forensic analysis on document	PLO 5,
	files or other artifacts.	PLO 6
	Students are able to analyze and assess forensics	PLO 4,
	on memory and disks to be applied in new or	PLO 5,
	different fields.	PLO 6

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	Students are able to plan or find a solution PLO 4,	
	scientifically to solve forensic investigation PLO 5,	
	problems in new devices such as Internet of PLO 6	
	Things devices and drones.	
Content	1. The concept of digital evidence: tangible evidence, best	
	evidence, direct evidence, digital evidence.	
	2. Methodology of forensic investigation: obtaining	
	information, developing strategies, gathering evidence,	
	analysis, reporting.	
	3. Collection of evidence: physical tapping (cable, radio	
	frequency, etc.), software to get the data (tcpdump,	
	wireshark, etc)	
	4. The concept of a file: file signature, forensic imaging, file	
	allocation table (FAT), NTFS, volume, partition.	
	5. Technical basics: packet analysis, flow analysis, evidence-	
	based resource network (firewalls, proxies, routers,	
	switches, server logs, etc.)	
Exams and assessment	Paper review and presentations	
formats		
Study and examination	The final grade is drawn from following components:	
requirements	• Paper review (Analysis with Autopsy): 20% of grade	
	• Presentation of 1 st paper: 20% of grade	
	• Presentation of 2 nd paper: 20% of grade	
	• Presentation of 3 rd paper: 20% of grade	
	• Presentation of 4 th paper: 20% of grade	
	Students must have a final grade of 61% or higher to pass this	
	course.	
Reading list	1. Forensic Science International: Digital Investigation.	
6	Elsevier	
	2. IEEE Transactions on Information Forensics and Security	
	3. Nelson, B., Phillips, A., & Steuart, C. (2019). Guide to	
	Computer Forensics and Investigations. Cengage	
	Learning.	
	4. Holt, T. J., Bossler, A. M. & Seigfried-Spellar K C	
	(2022) Cybercrime and digital forensics: An introduction	
	Routledge	
	koulleage.	

Module designation	Advance Topics in Mobile Computing	
Course Code	EF235115	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Dr.Eng. Radityo Anggoro, S.Kom., M.Sc.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, discovery learning, project-ba	ased learning
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	s 30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	30 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	Net-Centric Computing (EF235102)	
prerequisites for joining the		
module		
Course Description	This course learns and analyzes related issues ass	sociated with
	the development of the system in a mobile	e computing
	environment with an understanding of the characte	eristics of the
	environment and infrastructure in which the syste	m is located,
	move, or interacts. This course also studies	s supporting
	technologies and methodologies to solve probler	ns related to
	the purpose of the development of the achieved sy	/stem.
Module objectives/intended	Students are able to master the concepts and	PLO 1.
learning outcomes	principles of architecture, systems and the basics	PLO 6
	of networks in a mobile environment.	
	Students are able to define specific protocols	PLO 3,
	according to the network layer based on the	PLO 6
	characteristics of the mobile environment.	
	Students are able to develop protocols at the	
	network layer, both general and specific,	PLO 3,
	including setting performance measurements in	PLO 6
	mobile environments.	
	Students are able to improve protocol	PLO 2,
	performance to solve problems effectively and	PLO 6
	erriciently.	

Content	1. Wireless network technology and its limitations.	
	2. Characteristics and dimensions of a system that works in	
	the mobile environment.	
	3. Modelling and mobility characteristics of the mobile	
	environment.	
	4. Location management system that works on the mobile	
	environment.	
	5. Ad hoc networks, delay-tolerant, and its limitations,	
	routing, and superiority.	
	6. Latest issues related to mobile information access,	
	location-related application adaptation, energy, and	
	resource availability.	
	7. The development of spontaneous networking, mobile peer-	
	to-peer, and its application.	
	8. A variety of research topics in mobile computing.	
Exams and assessment	Quizzes, midterm assessment, and final project	
formats		
Study and examination	The final grade is drawn from the following components:	
requirements	• 1 st quiz: 15% of grade	
	• Midterm assessment: 35% of grade	
	• 2 nd guiz: 15% of grade	
	• Final project: 35% of grade	
	Students must have a final grade of 61% or higher to pass this	
	course.	
Reading list	1. Abdessalam Helal, et., al., "Anytime, Anywhere	
	Computing, Mobile Computing Concepts and	
	Technology", McGraw-Hill,	
	2. Mobile Computing Principles Designing And Developing	
	Mobile Applications With Uml And Xml and the	
	Environment", Oxford Publisher 2002.	
	3. Location Management and Routing in Mobile Wireless	
	Networks, Amitava Mukherjee, Somprakash	
	Bandyopadhyay, Debashis Saha, Artech House Publisher	
	4. Andreas Heinemann, Max Muhlhauser, Peer-to-Peer	
	Systems and Application	
	5. Mohammad Ilyas and Imad Mahgoub, Mobile Computing	
	Handbook, Auerbach Publication	
	6. IEEE Transaction of Mobile Computing, IEEE	
	7. Pervasive and Mobile Computing, Elsevier	

Module designation	Advance Topics in Cloud Computing	
Course Code	EF235116	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Royyana Muslim Ijtihadie, S.Kom., M.Kom., Ph.J	D.
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	This course discusses basic cloud technology,	mechanism,
	architecture, issues, challenges, and the newest research	
	technology of cloud computing. In addition,	this course
	discusses identifying research problems in cloud	d computing
	and their contributions.	
Module objectives/intended	Students are able to explain the definition,	
learning outcomes	paradigm and relevance between distributed	
	systems and cloud computing, including also	PLO 6
	synthesizing based on the characteristics of cloud	
	computing.	
	Students are able to understand certain topics in	PLO 2,
	cloud computing and can produce syntheses of	PLO 6
	Certain topics in cloud computing.	
	students are able to identify research problems	PLO 2,
	and carry out advanced elaboration on cloud	PLO 6
	Computing topics.	
	and correst out advanced eleberation to contribute	PLO 2,
	new knowledge	PLO 6
Content	1 Introduction to cloud computing fundamentally	7
Content	1. Incoduction to cloud computing fundamentally	/ •

	 The mechanism and holding security of cloud computing, architecture and delivery model on cloud computing, supporting cloud computing technologies, cloud computing cases and its implementations. The management of system and quality service on cloud computing.
Exams and assessmen formats	Presentations, write a paper and submit to national journals
Study and examination requirements	 The final grade is drawn from the following components: Presentation the topics to be researched: 25% of grade Create an idea and draft for scientific papers: 25% of grade Write a scientific paper: 25% of grade Submit the scientific paper to national journals: 25% of grade Students must have a final grade of 61% or higher to pass this course.
Reading list	 Cloud Computing Concepts, Technology & Architecture, Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, 2013, Pearson Data Center Handbook, Plan, Design, Build, and Operations of a Smart Data Center, Hwaiyu Geng, 2021, John Wiley & Sons, Inc Design Patterns for Cloud Native Applications, Patterns in Practice Using APIs, Data, Events, and Streams, Kasun Indrasiri and Sriskandarajah Suhothayan,2021, O'Reilly IEEE Transaction on Cloud Computing, IEEE Communication of the ACM, ACM

Course Code EF235122 Semester(s) in which the module is taught Odd A Person responsible for the module Dr. Ahmad Saikhu, S.Si., M.T. Module Indonesian Relation to curriculum Elective Teaching methods Lecture, discussion, program demo Workload (incl. contact hours, self-study hours) 1. Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 SKS x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 SKS x 60 = 180 minutes (3 hours) per week. Credit points 3 credit points (SKS) Required and recommended prerequisites for joining the module - Course Description The Advance Topics in Time Series Data Analysis course, various techniques and forecasting modeling based on statistics, neural networks and deep learning are studied. The multi-technique approach includes univariate and multivariate data and model evaluation based on forecasting model performance measures to obtain the best model. In this lecture, anomaly detection is also discussed. Learning is carried out through lectures, discussions, presentations and review of publication articles. In addition, students are given a case study assignment with the use of python tools, R-package. Module objectives/intended learning outcomes Students are able to explain the characteristics of univariate and multivariate time-series data and modeling techniquees
Semester(s) in which the module is taught Odd A Person responsible for the module Dr. Ahmad Saikhu, S.Si., M.T. Language Indonesian Relation to curriculum Elective Teaching methods Lecture, discussion, program demo Workload (incl. contact hours, self-study hours) 1. Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 SKS x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 SKS x 60 = 180 minutes (3 hours) per week. Credit points 3 credit points (SKS) - Required and recommended prerequisites for joining the module - Course Description The Advance Topics in Time Series Data Analysis course, various techniques and forecasting modeling based on statistics, neural networks and deep learning are studied. The multi-technique approach includes univariate and multivariate data and model evaluation based on forecasting model performance measures to obtain the best model. In this lecture, anomaly detection is also discussed. Learning is carried out through lectures, discussions, presentations and review of publication articles. In addition, students are given a case study assignment with the use of python tools, R-package. Module objectives/intended learning techniques Students are able to explain the characteristics of univariate time-series data and modeling techniques
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A Person responsible for the module Dr. Ahmad Saikhu, S.Si., M.T. Language Indonesian Relation to curriculum Elective Teaching methods Lecture, discussion, program demo Workload (incl. contact hours, self-study hours) 1. Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 SKS x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 SKS x 60 = 180 minutes (3 hours) per week. Credit points 3 credit points (SKS) - Required and recommended prerequisites for joining the module - Course Description The Advance Topics in Time Series Data Analysis course, various techniques and forecasting modeling based on statistics, neural networks and deep learning are studied. The multi-technique approach includes univariate and multivariate data and model evaluation based on forecasting model performance measures to obtain the best model. In this lecture, anomaly detection is also discussed. Learning is carried out through lectures, discussions, presentations and review of publication articles. In addition, students are given a case study assignment with the use of python tools, R-package. Module objectives/intended learning outcomes Students are able to explain the characteristics of modeling techniques
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modeling techniques
modeling techniques
Students are able to create statistics-based time PLO 2,
Series models and analyze the results. PLO 9
Students are able to find the best time series PLO 2,
and analyze the results
and analyze the results.
Ntudanta ara abla ta raviany and avalar

Content	1. Modelling of Forecasting Time Series Univariat
	2. Modelling of Forecasting Time Series Multivariat
	3. Modelling of Forecasting based on Neural Networks/Deep
	Learning
	4. Anomaly Detection dan Time Series Data Analysis
Exams and assessment	Presentations, paper review, and final project
formats	
Study and examination	The final grade is drawn from the following components:
requirements	• 1 st paper review and presentation (Forecasting modelling
	with ARIMA): 25% of grade
	• 2 nd paper review and presentation (Forecasting modelling
	of time series multivariate): 25% of grade
	• Project of time series multivariate with neural networks and
	deep learning: 25% of grade
	• Presentation of project: 25% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Time series Analysis, Univariate and Multivariate
	Methods, Second Edition, William W.S. Wei, 2006,
	Pearson Education Inc. Addison-Wesley
	2. Time series Analysis and Its Application, with R
	Examples, fourth Examples Robert H. Shumway, David S.
	Stoffer, Springer, 2017
	3. Deep Learning with R, François Chollet, 2017, Manning
	Publications
	4. Neural Networks for Time Series Forecasting With R,
	2017, Dr. N.D Lewis

Module designation	Advance Topics in Human and Computer Interacti	on
Course Code	EF235131	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Dr.Eng. Darlis Herumurti, S.Kom., M.Kom.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	This course is an introduction to research in the fiel	d of Human-
	Computer Interaction (HCI). This course introduc	es the theory
	of human physiology and psychology, hum	an-computer
	interaction principles, user-centered application	development
	process, research in the field of HCI steps, and exp	periment and
	evaluation in the HCI research. Through this cou	rse, students
	will get the opportunity to further explore resear	ch topics for
	develop or evaluations in the field of HCI.	
Module objectives/intended	Students are able to report and discuss the latest	PLO 3,
learning outcomes	research in the field of HCI.	PLO 8
	Students are able to apply HCI principles,	PLO 3.
	guidelines, methodologies, and techniques to	PLO 8
	software development.	1200
	Students are able to design, test, analyze, and	PLO 3,
	evaluate research in the field of HCI.	PLO 8
	Students are able to produce papers on HCI	PLO 2,
	topics in reputable international publications.	PLO 3
Content	1. Introduction of human-computer interaction	and research
	history in the field of human-computer intera	ction.

	2. Overview of human factors (physiology and psychology
	aspect) such as the sensory, motor, and cognitive
	characteristics in the relation to human computer
	interaction.
	3. The core elements of human interaction with computers:
	relation between display and control, metal and metaphor
	model, and interaction errors.
	4. Processes for user-centered development.
	5. The introduction of research steps in human-computer
	interaction: research methodology, observation and
	measurement, validation, and evaluation.
	6. Methodology and experiment design in the research in the
	field of human-computer interaction.
	7. Evaluation and hypothesis testing in the research in the
	field of human-computer interaction.
	8. Writing and publishing a research paper in the field of
	human-computer interaction.
Exams and assessment	Presentations, application demo, paper review, write a paper
formats	and submit to international conferences
Study and examination	The final grade is drawn from the following components:
requirements	• Presentation: 25% of grade
	• Application demo: 25% of grade
	• Paper review and presentation: 20% of grade
	• Presentation of research publication papers: 30% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Human-Computer Interaction: An Empirical Research
	Perspective; I. Scott MacKenzie • 2013
	2. Research Methods in Human Computer Interaction;
	Jonathan Lazar et.al, Second Edition • 2017
	3. ACM SIGCHI: <u>https://dl.acm.org/sig/sigchi</u>

Module designation	Advance Topics in Knowledge Based Engineering	
Course Code	EF235142	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Shintami Chusnul Hidayati, S.Kom., M.Sc., Ph.D	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	s 30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	30 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The purpose of this course is to provide a solid ad	lvanced level
	of issues, challenges, concepts, and techniques dea	aling with the
	organization and management of knowledge with	h the help of
	computers for system engineering. At the end o	f the course,
	students should be able to improve knowledge	engineering
	approaches for such systems either indep	endently or
	cooperatively.	
Module objectives/intended	Mastering fundamental and advanced concepts	PLO 2.
learning outcomes	behind the creation, acquisition, representation,	PLO 3.
	dissemination, use and reuse, and management	PLO 10
	of knowledge.	
	Mastering the fundamental and advanced	PLO 2,
	principles, methods, techniques, and tools used	PLO 5,
	in computer-supported knowledge engineering.	PLO 10
	Mastering fundamental and advanced concepts	
	and principles in the implementation and	PLO 2,
	integration of appropriate components and	PLO 10
	tunctions from various knowledge-based	
	systems engineering.	

		PLO 1,
	Able to critically evaluate current knowledge	PLO 2,
	management trends and their manifestation in	PLO 3,
	commerce and industry.	PLO 5,
		PLO 10
Content	1. Principles and advanced practices of	knowledge
	management	-
	2. Technical components of computer tools and	d technology
	for managing knowledge	
	3. Evaluation of the characteristics, re	presentation,
	availability, and utilization of knowledge	
	4. Management and the future of knowledge eng	gineering
Exams and assessment	Presentations and case studies	
formats		
Study and examination	The final grade is drawn from the following comp	oonents:
requirements	• 1 st presentation: 20% of grade	
	• 1 st case study (Implementation of the impro	ved artificial
	intelligence technology): 30% of grade	
	• 2 nd case study (Implementation of an impro	oved system,
	which supports direction and routines): 30% of	of grade
	• 2 nd presentation: 20% of grade	-
	Students must have a final grade of 61% or highe	r to pass this
	course.	
Reading list	1. Irma Becerra-Fernandez, Rajiv Sabherv	wal (2015).
	Knowledge Management: Systems and Proce	esses. Taylor
	& Francis. ISBN: 978-1-315-71511-7.	
	2. Diane Kitchin, Mauro Vallati (2020).	Knowledge
	Engineering Tools and Techniques for A	AI Planning.
	Springer International Publishing. ISBN:	978-3-030-
	38561-3.	
	3. Simon Kendal, Malcolm Creen (2007). An Ir	ntroduction
	to Knowledge Engineering. Springer. ISBN: 9	978-1-846-
	28475-5.	
	4. Papers related to topics in knowledge-based e	ngineering

Module designation	Advance Topics in Information Technology Gover	nance
Course Code	EF235143	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Dr. Ahmad Saikhu, S.Si., M.T.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, small group discussion, collaborat	ive learning,
	cooperative learning, discovery learning, p	roblem-based
	learning	
Workload (incl. contact hours,	1. Lectures: 3 SKS x $50 = 150$ minutes (2 hour	s 30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 12$	80 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Information Technology	Governance
	course, students will learn the importance of	f information
	technology governance, frameworks in information	on technology
	governance, information technology governance	development,
	maturity level calculations, gap analysis, and	information
	technology governance recommendations.	
Module objectives/intended	Students are able to explain several frameworks	PLO 9
learning outcomes	for information technology governance.	120 /
	Students are able to gap analysis using	
	information technology governance	PLO 9
	frameworks.	
	Students are able to measure the maturity level	
	of information technology implementation	PLO 4
	using an information technology governance	
	framework.	
	Students are able to provide recommendations	PLO 4
	for improving the implementation of	I LO T

	information technology governance using the
	information technology governance framework.
Content	1. Information technology governance framework (COBIT, TOGAF)
	2. Calculation of the maturity level of information technology
	governance
	3. Information technology governance implementation gap
	4. Analysis and provision of recommendations for the
	application of information technology governance
Exams and assessment	Case studies, midterm assessment, project, and presentation
formats	
Study and examination	The final grade is drawn from the following components:
requirements	• Case study: 25% of grade
	• Midterm assessment: 25% of grade
	• Project (Gap analysis between as-is and to-be in
	information technology governance): 25% of grade
	• Presentation of final project: 25% of grade
	Students must have a final grade of 61% or higher to pass this
	course
Reading list	1. Wallace, M., Webber, L. (2021). IT Governance: Policies
	& Procedures. Wolters Kluwer, New York
	2. TOGAF 9 Foundation Study Guide 4th edition
	3. COBIT 2019 Framework: Governance and Management
	Objectives
	4. ArchiMate Modeling. Link:
	https://www.archimatetool.com/
	5. Frogeri, R. F., Pardini, D. J., Cardoso, A. M. P., Prado, L.
	A., Piurcosky, F. P., & Junior, P. dos S. P. (2019). IT
	Governance in SMEs. International Journal of II/Business
	Alignment and Governance, $10(1)$, $55-73$ doi:10.4018/jijitbag.2019010104
	6 Janahi L. Griffiths M & Al-Ammal H (2015) A
	conceptual model for IT Governance: A case study
	research. International Conference on Computer Vision
	and Image Analysis Applications.
	doi:10.1109/iccvia.2015.7351894
	7. Silva, E., & Chaix, Y. (2008). Business and IT Governance
	Alignment Simulation Essay on a Business Process and IT
	Service Model. Proceedings of the 41st Annual Hawaii
International Conference on System Sciences (HICSS	
--	
2008). doi:10.1109/hicss.2008.83	

Module designation	Advance Topics in Geospatial Data Analysis	
Course Code	EF235145	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Dr. tech. Ir. Raden Venantius Hari Ginardi, M.Sc.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, small group discussion, project-based learning, case-	
Workload (incl. contact hours, self-study hours)	 Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes) per week. Exercises and Assignments: 3 SKS x 60 = 180 minutes (3 hours) per week. Private study: 3 SKS x 60 = 180 minutes (3 hours) per 	
Credit points	week.	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Geospatial Data Analysis course contain strengthening understanding of coordinate systems, digital maps, cartography, spatial analysis, and geographic information systems. In this course, methods and algorithms related to data management related to geographic spatial are discussed, including but not limited to global positioning systems, indoor positioning systems, location-based services, suitability analysis, 3d-spatial analysis, and interoperability in spatial data management, for example in the use of APIs to use online maps services. Lecture participants will explore research developments in the field of spatial data analysis and management and conduct experiments to produce research proposals and publications in the field of geospatial data analysis	
Module objectives/intended learning outcomes	Students are able to present project planning topics related to spatial data management using GIS Desktop.	PLO 2
	Students are able to design and solve spatial analysis problems.	PLO 2

	Students are able to explain the progress of	
	experiments in spatial data management using	PLO 10
	integrated online data.	
	Students are able to present drafts of scientific	
	articles that are ready to be published at	$\mathbf{D}\mathbf{I} \cap 10$
	international seminars or accredited national	PLO 10
	journals.	
Content	1. Coordinate System, Map Projection S	ystem, Map
	Digitization	
	2. Spatial analysis and 3d-spatial analysis	
	3. Indoor positioning system and Global Positic	oning System
	4. Location-based services	
	5. Data interoperability	
Exams and assessment	Practicum with project, assignment, presentati	on, literature
formats	review, and write a paper for research publication	
Study and examination	The final grade is drawn from the following com	ponents:
requirements	• Practicum with project (Managing spatial d	ata of digital
	maps with Desktop GIS): 20% of grade	
	• Project presentation (Suitability analysis): 20	% of grade
	• Presentation of literature review (Proposa	l in field of
	location-based services): 30% of grade	
	• Write a paper for research publication: 30% of	of grade
	Students must have a final grade of 61% or high	er to pass this
	course.	
Reading list	1. Michael J de Smith, Michael F Goodchild	, and Paul A
	Longley, Geospatial Analysis: A Comprehen	sive Guide to
	Principles, Techniques and Tools, 6-ed, The	e Winchelsea
	Press, 2018	
	2. A. Stewart Fotheringham, Chris Brunsdon	, and Martin
	Charlton, Quantitative Geography: Perspective	ves on Spatial
	Data Analysis, SAGE Publications Ltd; First	edition (May
	2, 2000)	
	3. The ESRI Guide to GIS Analysis, Volume 1	: Geographic
	Patterns and Relationships	

Module designation	Advance Topics in Software Testing		
Course Code	EF235155		
Semester(s) in which the	Odd		
module is taught			
A Person responsible for the	Prof. Daniel Oranova Siahaan, S.Kom., M.Sc., PD.Eng.		
module			
Language	Indonesian		
Relation to curriculum	Elective		
Teaching methods	Lecture, discussion, case method brainstorming pap	per review	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$		
self-study hours)	per week.		
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 180 \text{ minutes}$ (3)		
	hours) per week.		
	3. Private study: 3 SKS x $60 = 180$ minutes (3)	hours) per	
	week.		
Credit points	3 credit points (SKS)		
Required and recommended	-		
prerequisites for joining the			
module	· · · · · · · · · · · · · · · · · · ·		
Course Description	The Advance Topics in Software Testing course is part of the		
	Software Engineering family which discusses the	process of	
	validating and verifying a software using approache	es, methods,	
	and tools that are in accordance with the character	istics of the	
	software. Students will also review current research	h related to	
	software testing, as well as identify state-of-the-art methods,		
	issues, and challenges in software testing.	DI O O	
Module objectives/intended	Students are able to analyze and develop software	PLO 2,	
learning outcomes	verification and validation methods.	PLO 3,	
	Students are able to analyze and develop testing-	PLO 2,	
	based software development methods.	PLO 3,	
	Students are able to analyze and develop methods	PLO 2,	
	related to faults and defects in software.	$\frac{110}{9}$	
Content	1 Statics and dynamics approach to software veri	fication	
	2. Test-driven development	110001011	
	3. Planning and validation documentation		
	4. Object oriented testing; system testing		

	5. Verification and validation non-code artifacts
	(documentation, help files, training materials)
	6. Fault logging
	7 Fault tracking
	8 Fault estimation dan testing termination
	9 Defect seeding
Exams and assessment	Assignment paper review and presentation
formats	Assignment, paper review, and presentation
Study and avamination	The final grade is drawn from the following components:
Study and examination	The final grade is drawn from the following components.
requirements	• 1 st assignment (Statics and dynamics approach to software verification): 15% of grade
	• 2 nd assignment (Software development testing oriented):
	20% of grade
	• 3 rd assignment (Software verification and validation): 15%
	of grade
	• 4 th assignment (Fault analysis): 30% of grade
	• Presentation of paper review: 20% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Ralf Bierig, Stephen Brown, Edgar Galvan, and Joe
	Timoney, Essentials of Software Testing, Cambridge
	University Press 2021
	2 Ali Mili and Fairouz Tchier Software Testing: Concents
	and Operations (Quantitative Software Engineering
	Series) 1st Edition Wiley 2015
	3 Pressman R S Software Engineering: A Practitioner's
	Approach 8th Edition McGraw-Hill 2008
	4 IEEE Computer Society SWEROK v 3.0 IEEE 2014
	5 Annual Conformation Software Testing
	5. Annual Conference in Software Testing.

Module designation	Advance Topics in Data Mining	
Course Code	EF235161	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Prof. Dr.Eng. Chastine Fatichah, S.Kom., M.Kom	1.
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, case method	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$	
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 180 \text{ minutes}$ (3)	
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	Computational Intelligence (EF235101)	
prerequisites for joining the		
module		
Course Description	In this course, students will learn and develop	data mining
	techniques starting from the stages of data expl	oration, data
	preprocessing, clustering, association rule r	nining, and
	classification so that it becomes useful information	on to support
	decision making or solving a problem and publish	the results of
	their research in seminars or journals at r	national and
	international levels.	
Module objectives/intended	Students are able to explore and preprocess data	PLO 3,
learning outcomes	according to data characteristics and analyze the	PLO 5,
	results of application to a problem.	PLO 10
	Students are able to analyze and develop class	
	imbalance problem handling techniques and	PLO 3,
	ensemble classification methods and their use in	PLO 5
	classification problems.	
	Students are able to analyze and develop	PLO 3,
	association rule techniques, sequential pattern	PLO 5
	analysis, and their use in a problem.	
	Students are able to analyze and develop	PLO 3,
	clustering methods and their use in a problem.	PLO 5

	Students are able to analyze and develop anomaly detection techniques and their use in anomaly data.	PLO 3, PLO 5
	Students are able to develop data mining techniques on a real problem and publish the results of their research at national and international levels.	PLO 2
Content	 Introduction to data mining, data mining task data mining, data mining application, dat attribute types of data, data types. Pre-processing data: Quality of data: about noise, outliers, mi and data duplicate Cleaning of data: handling noise, identi removal outlier, imputation techniques. Transformation data: smoothing, maggregation, creating feature or att generalization Data Reduction: dimension reduction, feat data sampling Discretization data: binning, entropy-based Exploration and visualization of data Statistic method: frequency or mode, pero and median, range and variance Visualization: histogram, box plot, scatter plot, star plot, Chernoff's face Association rules: association rules conceptiented itemset, apriori algorithm, closed itemset algorithm, generate rules, mining multipus support Clustering: clustering types, clustering al Means, Hierarchical, Density-based, O validity cluster, and how to measure. Recommender systems and collaborative measures. 	cs, process in ca definition, ssing values, fication, and ormalization, tribute, and ure selection, d centile, mean plot, contour pts, frequent c, FP-growth le minimum gorithm (K- Graph-based), ve filtering:
	 recommendation system, recommendation recommendation content bases, collaborat technique. 7. Text mining: information retrieval, query, relevance feedback; clustering and document. 	model, and classification

	 8. Web mining: web content, web structure, and web usage 9. Mining spatial data: spatial data definition, analysis spatial association, classification data spatial. 10. Mining multimedia data: multimedia data, CBIR, and their application 11. Anomaly detection 12. Mining data stream: data stream, model, and some
	example applications. 13. Mining data stream technique (sliding window, counting bits, DGIM)
Exams and assessment formats	Assignment, paper review, final project, and presentation
Study and examination requirements	 The final grade is drawn from the following components: 1st assignment (Data exploration): 5% of grade 2nd assignment (Data preprocess technique): 5% of grade 3rd assignment (Classification method): 10% of grade Paper review from reputable international journals: 20% of grade 4th assignment (Association rule and sequential pattern analysis): 10% of grade 5th assignment (Clustering method): 10% of grade 6th assignment (Anomaly detection technique): 5% of grade Presentation of final project: 35% of grade Students must have a final grade of 61% or higher to pass this course.
Reading list	 Pang-Ning Tan; Michael Steinbach; Anuj Karpatne; Vipin Kumar, "Introduction to Data Mining 2nd edition", Addison-Wesley, 2019. Han, Jiawei, Kamber, Micheline, "Data Mining: Concept and Techniques 3rd edition", Morgan Kauffman Pub, 2011. Rajaraman, Anand, "Mining of Massive Datasets", Stanford University, 2011. Scientific articles of Data Mining in reputable international journal, such as IEEE Transactions on Knowledge and Data Engineering, ACM Transactions on Knowledge Discovery from Data, Expert System with Application, Data Mining and Knowledge Discovery, Journal of Big Data, etc.

Module designation	Advance Topics in Image Processing	
Course Code	EF235162	
Semester(s) in which the	Odd	
module is taught		
A Person responsible for the	Prof. Ir. Handayani Tjandrasa, M.Sc., Ph.D.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, group discussion	
Workload (incl. contact	1. Lectures: 3 SKS x $50 = 150$ minutes	(2 hours 30
hours, self-study hours)	minutes) per week.	
	2. Exercises and Assignments: 3 SKS x 60 =	180 minutes
	(3 hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Image Processing cours	e is designed
	to provide students with knowledge about imag	ge processing
	systems and their components so that student	s are able to
	analyze research that has been carried out in	the field of
	image processing and get concepts of how auto	mated image
	processing systems are formed in various ways	and methods
	so that they can apply them in the proposed	system both
	individually and in teamwork.	
Module objectives/intended	Students are able to analyze and apply pre-	
learning outcomes	processing of image processing in the spatial	PLO 2
	and frequency domains for further process	PLO 5
	preparation and are able to apply restoration	1200
	methods to repair degraded images.	
	Students are able to analyze and apply	
	segmentation methods with various methods	PLO 2,
	based on discontinuity and similarity, and	PLO 5
	morphological methods.	
	Students are able to analyze and apply feature	PLO 2,
	extraction methods that produce feature	PLO 5

	vectors as input to image classification	
	systems with machine learning.	
	Students are able to analyze and apply	
	pretrained and transfer learning CNN for	PLO 2,
	image classification, as well as UNet-based	PLO 5
	deep learning for semantic segmentation.	
	Students are able to analyze and develop	
	methods and applications in the field of image	PLO 2,
	processing.	PLO 5
Content	1. Introduction to Topics in Image Process	ing: Steps in
	digital image processing, components	of image
	processing systems, uses and application ex	xamples.
	2. Digital image preprocessing: contrast co	rrection with
	intensity transformation functions,	histogram
	processing, illumination equalization, re-	eflection and
	noise removal, lowpass and high pass spati	al filters, and
	spatial filter combination methods.	
	3. 2D Fourier transform, Discrete Fourier Tran	nsform (DFT)
	2D. Fast Fourier Transform 2D (FFT 2D).	DFT 2D and
	IDFT characteristics. Image filtering with	lowpass and
	high pass in frequency domains.	1
	4. Model restores image, Inverse filter. min	nimum mean
	square error Wiener filter, constrained least	squares filter
	(CLSF), periodic noise reduction, geometri	c registration
	with bilinear equations, warping, zooming.	6
	5. Segmentation by various methods: method	ods based on
	borders, threshold values, and regions. De	tect lines and
	circles with the Hough transform.	
	6. Morphological methods for dilation, eros	ion, opening,
	closing, template matching, boundary	extraction,
	thinning, image reconstruction, and waters	hed.
	7. Feature extraction: Descriptors with bound	dary features,
	descriptors with region features, principal c	omponents as
	feature descriptors, whole image feature	ures, feature
	transformation with invariance to scale (SI	FT).
	8. Use of machine learning such as neural net	works, SVM.
	and neuro-fuzzy, for digital image classific	ation.
	9. Image classification system using pretraine	d and transfer
	learning Convolutional Neural Networ	ks (CNNs).

	Semantic segmentation of images by using UNet-based
	deep learning architecture.
Exams and assessment	Assignment, paper analysis, midterm assessment,
formats	presentation and demo of final project
Study and examination	The final grade is drawn from the following components:
requirements	• 1 st assignment (Paper analysis about implementation of
	digital image preprocessing and filtering in the frequency
	domain): 15% of grade
	• 2 nd assignment (FFT 2D implementation and
	enhancement in spatial and frequency domain): 20% of
	grade
	• Midterm assessment: 20% of grade
	• 3 rd assignment (Paper analysis about preprocess and
	segmentation, morphology method, or feature
	extraction): 15% of grade
	• Presentation and demo of final project (Design and
	solving biomedical data problems): 30% of grade
	Students must have a final grade of 61% or higher to pass
	this course.
Reading list	1. R.C. Gonzalez and R.E. Woods, "Digital Image
	Processing", 4th ed., Pearson Education, Inc., 2018.
	2. W.K. Pratt, "Digital Image Processing", 4th ed., John
	Wiley & Sons, Inc., 2007.
	3. D. A. Forsyth and J. Ponce, "Computer Vision: A
	Modern Approach", 2nd ed., Pearson Education, Inc.,
	2012. 4 I. Goodfallow, V. Bongio, and A. Courville, "Doop
	4. I. Goodienow, T. Bengio, and A. Courvine, Deep Learning" MIT Press 2016
	5 W Birkfellner "Medical Image Analysis Methods"
	Taylor & Francis Group, LLC., 2014.
	6. IEEE Transactions on Image Processing.
	7. IEEE Transactions on Medical Imaging.
	8. Image and Vision Computing, Elsevier.
	9. Expert Systems with Applications, Elsevier.

Module designation	Research Methodology	
Course Code	EF235201	
Semester(s) in which the	2 nd	
module is taught		
A Person responsible for the	Dr. Bilqis Amaliah, S.Kom., M.Kom.	
module		
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, Project	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hour})$	s 30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: 3 SKS x 60 = 180 minutes (3 hours) per week	
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per
	week.	(0 1101110) per
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	Research Methodology course aims to sharpen think logically, critically, systematically, an through scientific research in the field of technology based on scientific principles, pro ethics in the form of theses and papers that have be in seminars or scientific journals both at international levels. Research methodology studi of the scientific method in developing research. T this course is a draft of research proposals associa research topic.	the ability to ad creatively science and ocedures, and een published national and ies the stages The output of ated with each
learning outcomes	Students are able to identify and compile the background, formulation and limitations of problems, goals, and contributions (novelty) of research.	PLO 4
	Students are able to identify and compile methodologies and literature reviews.	PLO 2
	Students are able to identify and compile the scope of research, design and implementation of proposed methods, data analysis, how to test	PLO 3

	their correctness and validity, and draw conclusions.	
	Students are able to compile research proposals based on scientific rules, procedures, and ethics.PLO 1	
Content	 Identify and understand background, formulation and limitations of problems, contributions, literature review of a scientific / research article. Identification and understanding methodology, data analysis, and conclusion of a scientific/research article. Plagiarism and citation procedures. Identification of the scope of research, design and implementation of the proposed methods, data analysis. Conduct tests of its correctness and validity, as well as 	
Exams and assessment formats	Assignments	
Study and examination requirements	 The final grade is drawn from the following components: 1st assignment (Background, problem formulations and limitations, objectives, and contributions): 25% of grade 2nd assignment (Methodology evolution and literature review): 25% of grade 3rd assignment (Design a methodology research): 25% of grade 4th assignment (Write a draft of proposal research): 25% of grade Students must have a final grade of 61% or higher to pass this course. 	
Reading list	 "Academic Writing: A Guide to Tertiary Level Writing", edited by Natilene Bowker, 2007. "Study Writing", by Liz Hamp-Lyons and Ben Heasley, 2006. 	

Module designation	Advance Topics in Multimedia Networking		
Course Code	EF235211		
Semester(s) in which the	Even		
module is taught			
A Person responsible for the	Prof. Tohari Ahmad, S.Kom., MIT., Ph.D.		
module			
Language	Indonesian		
Relation to curriculum	Elective		
Teaching methods	Lecture, discovery learning, project-based learning	ıg	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hourses})$	s 30 minutes)	
self-study hours)	per week.		
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	30 minutes (3	
	hours) per week.		
	3. Private study: 3 SKS x $60 = 180$ minutes ((3 hours) per	
	week.		
Credit points	3 credit points (SKS)		
Required and recommended	Net-Centric Computing (EF235102)		
prerequisites for joining the	the		
module			
Course Description	The Advance Topics in Multimedia Networks course studies		
	the concept of multimedia data, multimedia o	data delivery	
	methods, and security methods in utilizing multin	nedia data.	
Module objectives/intended	Students are able to analyze multimedia data	PLO 6	
learning outcomes	concepts.	1200	
	Students are able to explore methods of sending	PLO 6	
	multimedia data.	1200	
	Students are able to develop and implement	PLO 2	
	security methods utilizing multimedia data.		
	Students are able to analyze the methods and		
	results of trials and write them in a scientific	PLO 2	
	report.		
Content	1. The concept of multimedia data		
	2. Multimedia data transmission methods		
	3. Security methods in utilizing multimedia data	a ··· 1	
Exams and assessment	Assignments, presentations, and write a scientific article		
Iormats			
Study and examination	1 I ne final grade is drawn from following components:		
requirements	• 1 st presentation (Multimedia data concepts): 20% of grade		

	 2nd presentation (Multimedia data delivery methods): 20% of grade Assignment (Security methods utilizing multimedia data): 25% of grade Write a scientific article: 35% of grade Students must have a final grade of 61% or higher to pass this 	
	course.	
Reading list	 course. 1. Image and Video Encryption: From Digital Righ Management to Secured Personal Communication (Advances in Information security) by Andreas Uhl an Andreas Pommer (Feb 12, 2010). 2. Image and Video Processing in the Compressed Domain by Jayanta Mukhopadhyay (Mar 22, 2011). 3. Multimedia Communications and Networking by Marin Marques da Silva (Mar 14, 2012). 4. Fundamental Data Compression by Ida Mengyi Pu (Jan 1 2006). 5. Cryptography and Network Security: Principles an Brastiae (6th Edition) by William Stallings (Mar 16, 2012). 	

Module designation	Advance Topics in Network Security			
Course Code	EF235214			
Semester(s) in which the	Even			
module is taught				
A Person responsible for the	Prof. Tohari Ahmad, S.Kom., MIT., Ph.D.			
module				
Language	Indonesian			
Relation to curriculum	Elective			
Teaching methods	Lecture, discovery learning, small group discus	sion, project-		
	based learning, self-directed learning			
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hour})$	s 30 minutes)		
self-study hours)	per week.			
	2. Exercises and Assignments: 3 SKS x $60 = 18$	80 minutes (3		
	hours) per week.			
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per		
	week.			
Credit points	3 credit points (SKS)			
Required and recommended	Net-Centric Computing (EF235102)			
prerequisites for joining the				
module				
Course Description	The Advance Topics in Network Security course studies,			
	analyzes, and develops network security method	ods and their		
	applications. Case studies are used during the lea	rning process		
	to deepen students' understanding. This in	ncludes data		
	concealment methods, intrusion detection	systems and		
	dynamic data protection.			
Module objectives/intended	Students are able to analyze the concept of			
learning outcomes	network security and the factors that influence	PLO 6		
	it.			
	Students are able to explore methods of securing	PLO 6		
	data in the network.			
	Students are able to develop and implement	PLO 2		
	security methods in more detail.			
	Students are able to analyze the results of trials	PLO 2		
	and write them down in a scientific report.			
Content	1. The basic concept of computer security:	information		
	security, computer network security, information	ation systems		
	security, security software; Security	properties:		

	confidentiality, integrity, availability, authentication, non-
	repudiation, scalability.
	2. DDOS, session management, SQL injection, XSS, cookies
	3. Method of symmetrical and asymmetrical; theory and
	examples of classical and modern encryption, block and
	stream; use of substitution, transposition
	4. Method of securing data: hash function, steganography,
	MAC, digital signature.
	5. Authentication method: password, token, fingerprint;
	principles of remote authentication; the use of symmetric
	and asymmetric encryption to authenticate remotely;
	protocols: The 53erberos; federated identity
	6. Types and characteristics of IDS, IPS, firewalls
	7. The use of VPN, IDS, firewall, honeypot
Exams and assessment	Assignments and write a scientific report
formats	
Study and examination	The final grade is drawn from following components:
requirements	• 1 st assignment (Concepts and factors that influence
	network security): 20% of grade
	• 2 nd assignment (Network data security methods): 20% of
	grade
	• 3 rd assignment (Development of network data security
	methods: 25% of grade
	• Write a scientific report based on test results: 35% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Cryptography and Network Security: Principles and
	Practice (6th Edition) by William Stallings (Mar 16, 2013).
	2. Secure Coding in C and C++ (2nd Edition) (SEI Series in
	Software Engineering) by Robert C. Seacord (Apr 12,
	2013).
	3. Biometric Cryptography Based on Fingerprints:
	Combination of Biometrics and Cryptography Using
	Information from a fingerprint by Martin Drahansky (May
	23, 2010).
	4. Information Security the Complete Reference, Second
	Edition by Mark Rhodes-Ousley (Apr 3, 2013).

Module designation	Advance Topics in Wireless Network		
Course Code	EF235217		
Semester(s) in which the	Even		
module is taught			
A Person responsible for the	Prof. Ir. Supeno Djanali, M.Sc., Ph.D.		
module			
Language	Indonesian		
Relation to curriculum	Elective		
Teaching methods	Lecture, discussion		
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$		
self-study hours)	per week.		
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 180 \text{ minutes}$ (3)		
	hours) per week.		
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per	
	week.		
Credit points	3 credit points (SKS)		
Required and recommended	-		
prerequisites for joining the			
module			
Course Description	Students are able to understand correctly the issues related to		
	Wireless Networks, able to identify and analyze limitations and		
	Network and the to explain applications related	to wireless	
	to Wineless Networks	opics related	
Madula abjactivas/intended	Students are able to identify issues related to		
learning outcomes	wireless networks: challenges limitations and	PLO 3,	
learning outcomes	developments	PLO 5	
	Students are able to search and analyze several	PLO 2	
	topics in wireless networks	PLO 5	
	Students are able to explain applications related	PLO 2	
	to wireless networks	PLO 5	
		PLO 6	
	Students are able to write scientific papers with	PLO 2.	
	topics related to wireless networks.	PLO 3.	
	1	PLO 5.	
		PLO 6	
Content	1. The introduction and development of wireless networks		

	2. Pipelined protocols: Go-back-N, Selective Repeat, TCP:
	TCP reliable data transfer; TCP fast retransmit; TCP flow
	control
	3. Encoding Technique, Routing Mobile Ad-hoc: Pro-active,
	Reactive, Hybrid
	4. Wireless Standards IEEE 802.11: IEEE 802.11 MAC
	Protocol: CSMA/CA Coordination Function MAC: DCF;
	PCF
	5. Overview VANET; Physical Layer and MAC protocols
	VANET, VANET Application
	6. Wireless Sensor Network: Main feature WSN, WSN
	Application, WSN Limitations, Routing in WSN
	7. IoT Layer Model; sensor and actuator. Information
	processing (Middleware), IoT application
Exams and assessment	Assignment, presentations, and write a scientific article
formats	
Study and examination	The final grade is drawn from following components:
requirements	• Assignment (Wireless networks issues and IEEE 802.11
	standard): 20% of grade
	• 1 st presentation (VANET, WSN, and IoT): 30% of grade
	• 2 nd presentation (Proposed topics for scientific article):
	20% of grade
	• Write a scientific article about wireless networks: 30% of
	grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Kurose & Ross, "Computer Networking – A Top-Down
	Approach 6th Edition". Addison-Wesley, 2013.
	2. Stallings, W., "Wireless Communications and Networks
	2nd Edition", Prentice Hall, 2005.
	3. Eldad & Robert, "Next Generation Wireless LANs 802.11n
	and 802.11ac" Cambridge University Press 2008, 2013
	4. Tanenbaum & Wetherall, "Computer Networks" 5 th
	Edition, Prentice Hall, 2011.
	5. Claudia, Antonella and Riccardo, Editors. "Vehicular ad
	hoc Networks: Standards, Solutions, and Research"
	6. Springer International, 2015
	/. Shuang-Hua Yang, "Wireless Sensor Networks: Principles,
	Design and Applications" Springer-Verlag London 2014

8.	Rajkumar Buyya and Amir Vahid Dastjerd	i, Editors.
	"Internet of Things: Principles and Paradigms	s" Elsevier
	Inc. 2016	

Module designation	Advance Topics in Network Design and Audit		
Course Code	EF235218		
Semester(s) in which the	Even		
module is taught			
A Person responsible for the	Dr.Eng. Radityo Anggoro, S.Kom., M.Sc.		
module			
Language	Indonesian		
Relation to curriculum	Elective		
Teaching methods	Lecture, discovery learning, project-based learnin	g	
Workload (incl. contact hours,	1. Lectures: 3 SKS x $50 = 150$ minutes (2 hours	30 minutes)	
self-study hours)	per week.		
	2. Exercises and Assignments: 3 SKS x $60 = 180$ minutes (3		
	hours) per week.		
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per	
	week.		
Credit points	3 credit points (SKS)		
Required and recommended	-		
prerequisites for joining the			
module			
Course Description	The Advance Topics in Network Design and Audit course		
	provides knowledge of the unique characteristics that exist in		
	mobile networks. Students are guided to be ab	ole to define	
	problems that arise in mobile networks and are asl	ked to design	
	the right routing protocol to solve problems	on mobile	
	networks which can then be developed	to improve	
	performance.		
Module objectives/intended	Students are able to master the concepts and	PLO 1	
learning outcomes	principles of architecture, systems and the basics	PLO 6	
	of mobile networks.	1200	
	Students are able to define the type of mobile	PLO 3,	
	network communication.	PLO 6	
	Students are able to define specific routing	PLO 3	
	protocols based on the characteristics of mobile	PLO 6	
	networks.	1200	
	Students are able to improve protocol	PLO 2	
	performance to solve problems effectively and	PLO 6	
	efficiently.	1200	
Content	1. Requirement Analysis: User, application, devi	ice, network,	
	and other requirements concept and process.		

	2. Flow Analysis: Data Sources and Sinks, Flow Model, Flow
	Prioritization.
	3. Network Architecture: Network, routing, addressing,
	network management, performance, security, and privacy
	architecture.
	4. Network Design: Design concept, process concept,
	evaluation, network layout, metrics.
Exams and assessment	Assignment and write a scientific article
formats	
Study and examination	The final grade is drawn from following components:
requirements	• 1 st assignment (Concept and characteristics of conditions
	for the deployment of mobile networks): 15% of grade
	• 2 nd assignment (Advantages and disadvantages of
	communication types in mobile networks): 35% of grade
	• 3 rd assignment (Type of routing protocol): 15% of grade
	• Write a scientific article based on test results of routing
	protocol modification: 35% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Pei Zheng, Larry L. Peterson, Bruce S. Davie, Adrian
8	Farrel, Wireless Networking Complete, 2009, Morgan
	Kaufmann
	2. Abdessalam Helal, et. al., "Anytime, Anywhere
	Computing Mobile Computing Concepts and
	Technology". McGraw-Hill.
	3. Mobile Computing Principles Designing and Developing
	Mobile Applications with UML And XML and the
	Environment". Oxford Publisher 2002.
	4. Location Management and Routing in Mobile Wireless
	Networks. Amitava Mukheriee Somprakash
	Bandvonadhvav Debashis Saha Artech House Publisher
	5 Andreas Heinemann Max Muhlhauser" Peer-to-Peer
	Systems and Application
	6. Mohammad Ilvas and Imad Mahgoub Mobile Computing
	Handbook, Auerbach Publication
	7. IEEE Transaction of Mobile Computing IEEE
	8 Pervasive and Mobile Computing Elsevier
	o. Tervasive and whome computing, Disevier

Module designation	Advance Topics in Modelling and Simulation
Course Code	EF235221
Semester(s) in which the	Even
module is taught	
A Person responsible for the	Prof. Dr. Ir. Joko Lianto Buliali, M.Sc.
module	
Language	Indonesian
Relation to curriculum	Elective
Teaching methods	Lecture, case-based learning, demo
Workload (incl. contact	1. Lectures: 3 SKS x $50 = 150$ minutes (2 hours 30
hours, self-study hours)	minutes) per week.
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 180 \text{ minutes}$
	(3 hours) per week.
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.
Credit points	3 credit points (SKS)
Required and recommended	-
prerequisites for joining the	
module	
Course Description	The Advance Topics in Modelling and Simulation course
	aims to explore the concepts of modelling, computing, and
	statistics that have been possessed by lecture participants at
	the previous level of education. The application of Modelling
	and Simulation can be found, among others, in the
	application of inventory control, scheduling, production
	processes in companies, business processes in industry,
	traffic management, etc. In general, the purpose of
	simulation is to obtain an estimate of the performance of the
	simulated system, which in turn is used as support for
	decision making on one or more parameters of the simulated
	system performance. This course contains advanced topics of
	modelling and simulation, namely topics that focus on
	system modelling and analysis, simulation and visualization,
	which are aimed at design, prototyping, operational
	problems, including maintenance and the life cycle of a
	system that considers more than one performance
	parameters. Other focuses in the course include systems
	modelling techniques, object-oriented simulation,

	continuous simulation. Case studies include traffic		
	management, operations management, service management.		
Module objectives/intended	Students are able to explain the concept of		
learning outcomes	simulation, how simulation works, and under PLC		
	what circumstances simulation helps find	PLO 9	
	solutions to stochastic problems.		
	Students are able to create a simulation model		
	from a given problem description and execute	PLO 2,	
	the resulting simulation model using	PLO 9	
	simulation tools.		
	Students are able to analyze complex	PLO 2	
	problems and use advanced simulation	$\frac{1102}{2}$	
	techniques to produce simulation models.	FLO 9	
	Students are able to analyze the output of the	PLO 2,	
	simulation execution results.	PLO 9	
Content	1. Simulation Fundamentals, Simulation M	Methodology,	
	Problem Solving with Simulation,	Simulation	
	Formulation Model from Problem Descript	tion.	
	2. Analysis and System Modelling which co	onsider more	
	than one performance measure.		
	3. Advanced Simulation Technique to creat	e simulation	
	model, including agent-based simulation,	object based	
	simulation.		
	4. Output analysis based on result simulation	execution.	
Exams and assessment	Exercises, demo program, and presentation		
formats			
Study and examination	The final grade is drawn from following compo	onents:	
requirements	• 1 st exercise and program demo (Syster	n simulation	
	case): 25% of grade		
	• 2 nd exercise (Simulation models and prob	olem analysis	
	of scientific papers on system simulati	on): 25% of	
	grade		
	• 3 rd exercise and demo program (Creati	ng a system	
	simulation model): 25% of grade		
	• Presentation of simulation model case st	udy: 25% of	
	grade		
	Students must have a final grade of 61% or high	her to pass	
	this course.		

Reading list	1.	Discrete-Event System Simulation 5th Edition. Jerry
		Banks, John Carson, Barry Nelson, David Nicol.
		Pearson, 2009.
	2.	Simulation Modelling and Analysis, 5th Edition. Averill
		M. Law. McGraw-Hill Education. 2013.
	3.	Excel Simulations, Gerard M. Verschuuren. Holy
		Macro! Books. 2013.
	4.	Introduction to Simulation and Risk Analysis 2nd
		Edition. James R. Evans, David L. Olson, James R.
		Evans. Prentice Hall. 2001.

Module designation	Advance Topics in Multivariate Data Analysis	
Course Code	EF235223	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Dr. Ahmad Saikhu, S.Si., M.T.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, demo	
Workload (incl. contact	1. Lectures: 3 SKS x $50 = 150$ minutes (2)	2 hours 30
hours, self-study hours)	minutes) per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 1$	80 minutes
	(3 hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3)	8 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Multivariate Data Analys	is course, is
	discussed including data dimension reduction	n methods,
	grouping methods both supervised and unsuperv	ised, Factor
	Analysis and methods of modelling the relations	hip between
	multivariate dependent variables and independe	nt variables
	which include MANOVA, MANACOVA, I	Multivariate
	Regression, Logistic Regression, and Quality	tative Data
	Analysis (Log-Linear, Conjoint Analysis a	and Multi-
	Dimensional Scaling).	
Module objectives/intended	Students can identify types of analysis and	PLO 2
learning outcomes	models that are suitable for various types of	PLO 9
	data using univariate and multivariate methods.	120 /
	Students can find the best model for data	PLO 2
	dimension reduction, group modelling	PLO 9
	(clustering), classification, and factor analysis.	120)
	Students can model interdependence	
	relationships between variables that are	PLO 2,
	multivariate using the PCA, Manova/Manacova	PLO 9
	and Canonical Correlation methods.	

	Students are able to review and explain PLO 2,
	published articles in the field of multivariate PLO3,
	data analysis and modelling. PLO 9
Content	1. Introduction to Multivariate Data Analysis and
	Requirements for using it methods for modelling
	2. Interdependence Analysis on Multivariate Data Analysis
	3. Analysis of Dependent and Independent multivariate
	models
	4. Qualitative Multivariate Data Analysis (Log-linear,
	MDS, Conjoint)
	5. Path Analysis and SEM
Exams and assessment	Program demo and presentation
formats	
Study and examination	The final grade is drawn from following components:
requirements	• 1 st program demo (Group Prediction Model): 25% of
	grade
	• 1 st presentation (Qualitative Data Model): 25% of
	grade
	• 2 nd program demo (Perceptual Data Model): 25% of
	grade
	• 2 nd presentation (Path Analysis and SEM): 25% of
	grade
	Students must have a final grade of 61% or higher to pass
	this course.
Reading list	1. Barbara G. Tabachnick, Linda S. Fidell, "Using
_	Multivariate Statistics", Fifth Edition, Pearson Int.,
	2007.
	2. Hair, Joseph F., et. al., "Multivariate Data Analysis",
	Sixth Edition, Prentice Hall, New Jersey, 2006.
	3. Richard A. Johnson, Dean W. Wichern, "Applied
	Multivariate Statistical Analysis", Sixth Edition,
	Prenctice Hall International Inc, 2006.

Module designation	Advance Topics in Game Development, Virtual Reality, and Augmented Reality	
Course Code	EF235232	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Hadziq Fabroyir, S.Kom., Ph.D.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, group discussion	
Workload (incl. contact	1. Lectures: 3 SKS x $50 = 150$ minutes	(2 hours 30
hours, self-study hours)	minutes) per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 =$	180 minutes
	(3 hours) per week.	(2.1
	3. Private study: 3 SKS x 60 = 180 minutes week.	(3 hours) per
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	This course covers the research needed for the	
	implementation of immersive environments on the Reality X	
	platform, namely virtual reality, augmented reality, and	
	mixed reality, along with game mechanics	into it. The
	discussion will combine computational and inter	raction topics
	including the evolution of several assistive techn	nologies such
	as visual displays, motion tracking, interactive	3D graphics,
	multimodal sensor integration, spatial audio, us	er interfaces,
	loT, games, experience design, game	development
	techniques, and game mechanics. Through	this lecture,
	students are expected to be able to conduct res	search on the
	realm of games and reality x, model objects in a virtual	
	environment, program interactions between use	rs and virtual
	objects, and develop reality x using game eng	ines to solve
	problems in the real world.	
Iviodule objectives/intended	Students are able to report and discuss the	PLO 2,
learning outcomes	latest research in the fields of gaming, virtual	PLO 8
	reality and augmented reality.	

	Students are able to apply principles, guidelines, methodologies and techniques for game-based software development, virtual reality and augmented reality. Students are able to carry out trial design, analysis and evaluation on research in the fields of games, virtual reality and augmented reality. Students are able to produce paper manuscripts on the topic of games, virtual reality or augmented reality for international	PLO 2, PLO 8 PLO 2, PLO 8 PLO 2, PLO 2, PLO 2,
	conference publications.	1200
Content	 Basics of Game Development and Research Basis for Development and Research of X I Spectrum Display X Reality (VR/AR/MR) Interaction with Reality Development of Game or Reality X Appl Game Engines Writing Scientific Papers in the Field or Reality 	n Reality ications with of Games or
Exams and assessment formats	Presentation, paper review, and write a scientifi	c report
Study and examination requirements	 The final grade is drawn from following composed of the second second	onents: papers in the ade 1 of game s of game e application igher to pass
Reading list	 Schell, Jesse. Tenth anniversary: The art of A book of lenses. AK Peters/CRC Press, 20 Jerald, Jason. The VR book: Human-centro virtual reality. Morgan & Claypool, 2015. IEEE Transactions on Computational Inte AI in Games IEEE Transactions on Cybernetics 	game design:)19. ed design for elligence and

5.	IEEE Transactions Systems, Man and Cybernetics
6.	ACM SIGCHI
7.	Human-Computer Interaction: An Empirical Research
	Perspective; I. Scott MacKenzie • 2013
8.	Research Methods in Human Computer Interaction;
	Jonathan Lazar et.al, Second Edition • 2017

Module designation	Advance Topics in Computer Graphics	
Course Code	EF235233	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Dr. Anny Yuniarti, S.Kom., M.Comp.Sc.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, group discussion	
Workload (incl. contact	1. Lectures: 3 SKS x $50 = 150$ minutes	(2 hours 30)
hours, self-study hours)	minutes) per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 =$	180 minutes
	(3 hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes ((3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Computer Graphics co	ourse studies
	several types of methods that can be used to ma	nipulate data
	to be visualized on computer output device	ces such as
	monitors. In this course, the latest methods in	n developing
	computer graphics applications are discussed.	
Module objectives/intended	Able to explain topics in computer graphics	PLO 2,
learning outcomes	with the latest literature studies.	PLO 8
	Able to implement the latest methods in	PLO 2,
	computer graphics.	PLO 8
	Able to implement scientific principles,	
	procedures and ethics in the form of papers	PLO 2
	published in national or international journals.	FLO 8
Content	1. Non-photo realistic (NPR) rendering	
	2. Image-based rendering	
	3. Virtual painting	
	4. Silhouette detection	
	5. Texture generation/texture synthesis	
	6. Particle systems	
Exams and assessment	Presentation, paper review, and write a scientifi	c report
formats		

Study and examination	The final grade is drawn from following components:	
requirements	• 1 st assignment (NPR and image-based rendering):	
	10% of grade	
	• 2 nd assignment (Virtual painting and silhouette	
	detection): 10% of grade	
	• Program demo and analysis report: 30% of grade	
	• 3 rd assignment (Texture generation/texture synthesis	
	and particle systems): 10% of grade	
	• 4 th assignment (Particles combination and textures):	
	40% of grade	
	Students must have a final grade of 61% or higher to pass	
	this course.	
Reading list	1. Bénard, Pierre; Hertzmann, Aaron (2019). "Line	
	Drawings from 3D Models: A Tutorial". Foundations and	
	Trends in Computer Graphics and Vision. 11 (1-2): 1-	
	159.	
	2. Ce Zhu; Shuai Li (2016). "Depth Image Based View	
	Synthesis: New Insights and Perspectives on Hole	
	Generation and Filling". IEEE Transactions on	
	Broadcasting. 62 (1): 82–93.	
	doi:10.1109/TBC.2015.2475697	
	3. Beltramello A, Scalera L, Seriani S, Gallina P. Artistic	
	Robotic Painting Using the Palette Knife Technique.	
	Robotics. 2020; 9(1):15.	
	https://doi.org/10.3390/robotics9010015	
	4. Ivo, Rafael Fernandes et al. "Improved silhouette	
	rendering and detection of splat-based models." Comput.	
	Graph. 93 (2020): 39-50.	

Module designation	Advance Topics in System Audit	
Course Code	EF235241	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Prof. Drs.Ec. Ir. Riyanarto Sarno, M.Sc., Ph.D.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discovery learning, cooperative lear	ning, group
	discussion, project-based learning, case study	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Systems Audit course is	designed to
	provide knowledge and encourage students to con-	duct analysis
	related to system auditing, from process design	n to making
	recommendations based on best practices.	
Module objectives/intended	Students are able to understand the purpose of	
learning outcomes	information technology audits and identify and	PLO 2,
	analyze process and information risks related to	PLO 10
	confidentiality, integrity and availability.	
	Students are able to analyze and develop audit	PLO 2,
	processes that suit enterprise needs.	PLO 10
	Students are able to analyze and develop control	PIO2
	procedures and measurements to manage risk	PLO 10
	effectively.	12010
	Students are able to identify, analyze and make	
	recommendations for improving system	PLO 2
	performance by referring to examples of best	PLO 10
	practices, standards and regulations of	12010
	information technology governance.	

Content	1. Information System/Information Technology governance
	concepts
	2. Governance framework
	3. Control objectives
	4. System audit planning
	5. Business process audit
	6. Audit implementation and evaluation
	7. Audit reporting and recommendations
Exams and assessment	Presentation and write a scientific article
formats	
Study and examination	The final grade is drawn from following components:
requirements	• 1 st assessment (Create a conceptual research design related
	to IS/IT System Audit): 20% of grade
	• 2 nd assessment (Preparation of initial drafts of scientific
	articles and group presentations related to IS/IT System
	Audit): 30% of grade
	• 3 rd assessment (Progress drafts of scientific articles and
	group presentations related to IS/IT System Audit): 20%
	of grade
	• 4 th assessment (Final presentation of scientific articles
	related to IS/IT System Audit): 30% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. Riyanarto Sarno, Audit Sistem Informasi/Teknologi
	Informasi, ITS Press, 2009.
	2. Riyanarto Sarno, Strategi Sukses Bisnis dengan Teknologi
	Informasi Berbasis Balanced Scorecard dan COBIT, ITS
	Press, 2009, ISBN 978-979-8897-42-9.
	3. ISO/IEC 38500:2008 Corporate Governance of
	Information Technology
	4. Sandra Senft, Frederick Gallegos, Daniel P. Manson, Carol
	Gonzales. Information Technology Control and Audit
	Second Edition. CRC Press, 2009. ISBN 978-0849320323
	5. Davis, M. Schiller, & K. Wheeler. IT auditing: using
	controls to protect information assets. New York:
	McGraw-Hill. 2007
	6. Simha R. Magal, Integrated Business Processes with ERP
	Systems, John Wiley & Sons, Inc., 2014.
	7. Riyanarto Sarno & Irsyat Iffano, Sistem Manajemen
	Keamanan Informasi, ITS Press, 2009.

Module designation	Advance Topics in Big Data	
Course Code	EF235244	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Abdul Munif, S.Kom., M.Sc.Eng.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, project-based learning	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	Computational Intelligence (EF235101)	
prerequisites for joining the		
module		
Course Description	The Advance Topics in Big Data course mat	terial equips
	students to analyze the design and architecture o	f large-scale
	data storage systems, develop distributed	computing
	frameworks on big data, develop large	-scale data
	processing/mining processes in real cases, and op	timize large-
	scale data processing.	
Module objectives/intended	Students are able to analyze the design and	
learning outcomes	architecture of large-scale data storage systems	PLO 2
	(Hadoop, graph database, cloud storage, etc.).	
	Students are able to develop distributed	
	computing frameworks on big data (Map-	PLO 2
	Reduce, Apache Spark).	
	Students are able to develop large-scale data	
	processing/mining processes in real cases	PLO 10
	(classification, regression, clustering,	
	recommendation systems, and social networks).	
	Students are able to optimize large-scale data	PLO 10
	processing.	
Content	1. Data mining	
	2. Map-Reduce and Distributed Computing	

	3. Large-scale data processing algorithms/modeling: Finding	
	similar items, mining data streams, link analysis, frequent	
	item sets, clustering, classification, recommendation	
	systems, mining social-network graph.	
	4. Optimization of large-scale data processing:	
	Dimensionality reduction, large-scale machine learning,	
	neural network, deep learning	
Exams and assessment	Assignments, presentation, midterm assessment, and final	
formats	assessment	
Study and examination	The final grade is drawn from following components:	
requirements	• 1 st presentation (Processing data streams): 25% of grade	
	• Midterm assessment: 25% of grade	
	• 2 nd presentation (Social network data processing): 25% of	
	grade	
	• Final assessment: 25 % of grade	
	Students must have a final grade of 61% or higher to pass this	
	students must have a final grade of of 76 or higher to pass this	
	course.	
Reading list	1. Leskovec, J., Rajaraman, A., & Ullman, J. D. (2019).	
	Mining of Massive Datasets (3rd ed.). Stanford University.	
	2. Chambers, B., & Zaharia, M. (2018). Spark: The Definitive	
	Guide. O'Reilly Media, Inc.	
	3. Shi, Y. (2022). Advances in Big Data Analytics. Springer	
	Nature Singapore Pte Ltd.	
	4. Wolohan, J. T. (2019). Mastering Large Datasets with	
	Python. Manning Publication Co.	
Course CodeEF235246Semester(s) in which the module is taughtEvenA Person responsible for the moduleAbdul Munif, S.Kom., M.Sc.Eng.LanguageIndonesianRelation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours1Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes)		

Semester(s) in which the module is taughtEvenA Person responsible for the moduleAbdul Munif, S.Kom., M.Sc.Eng.LanguageIndonesianRelation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours1Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes)		
module is taughtA Person responsible for the moduleAbdul Munif, S.Kom., M.Sc.Eng.LanguageIndonesianRelation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours1Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes)		
A Person responsible for the moduleAbdul Munif, S.Kom., M.Sc.Eng.LanguageIndonesianRelation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours1Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes)		
moduleLanguageIndonesianRelation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours1Lectures: 3 SKS x 50 = 150 minutes (2 hours 20 minutes)		
LanguageIndonesianRelation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours1Lectures: 3 SKS x 50 = 150 minutes (2 hours 30 minutes)		
Relation to curriculumElectiveTeaching methodsLecture, discussionWorkload (incl. contact hours:1Lectures:3SKS x 50 = 150 minutes (2 hours 20 minutes)		
Teaching methodsLecture, discussionWorkload (incl. contact hours:1Lectures:3SKS x 50 = 150 minutes (2 hours:20 minutes)		
Workload (incl. contact hours 1. Lectures: $3 \text{ SKS y } 50 - 150 \text{ minutes}$ (2 hours 20 minutes)		
workload (mer. contact nours, $ $ 1. Lectures. 5 SKS x 50 – 150 minutes (2 nours 50 minutes)		
self-study hours) per week.		
2. Exercises and Assignments: 3 SKS x $60 = 180$ minutes (3		
hours) per week.		
3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per		
week.		
Credit points 3 credit points (SKS)		
Required and recommended -		
prerequisites for joining the		
module		
Course Description The Advance Topics in Quantum Computing course equips		
students with quantum computing paradigm material, the		
advantages and limitations of quantum computing, quantum		
mechanical postulates and their applications to computation,		
quantum information principles and quantum communication,		
fundamental quantum algorithms, and the implications of		
quantum computing on machine learning, cryptography and		
information security.		
Module objectives/intended Students are able to explain the paradigm of PLO 2		
learning outcomes quantum computing.		
Students are able to analyze the advantages and PLO 2		
limitations of quantum computers.		
Students are able to explain the four postulates		
of quantum mechanics and their application to PLO 2		
Studente ere chle te evelein the principles of		
students are able to explain the principles of quantum information and quantum PLO 10		
quantum mormation and quantum FLO 10		
Students are able to analyze fundamental		
quantum algorithms. PLO 10		

	Students are able to explain the implications of				
	qua	ntum computing on machine learning,	PLO 10		
	cryp	ptography and information security.			
Content	1.	Quantum computing paradigm			
		a. Global perspective of quantum computing	5		
		b. Quantum Bits			
		c. Quantum Computing			
		d. Quantum algorithms			
		e. Experimental quantum information process	ssing		
		f. Quantum Information			
	2.	2. Advantages and limitations of quantum computers			
		a. Identify the advantages of quantum computing			
		b. Identification of possible problems to b	e accelerated		
		using quantum computing			
		c. Limitations of quantum algorithms			
	3.	3. Four postulates of quantum mechanics and the			
		application to computing			
		a. Design and analysis of quantum algorithms			
		b. Quantum states, unitary evolution, measurements,			
		composite systems			
		c. Definition of postulates in density matrice	es		
	4.	Principles of quantum information and	nd quantum		
		communication			
		a. Quantum teleportation and its limitations			
		b. Framework for quantum error correction	code		
		c. Everett's many worlds interpretation			
	5.	Quantum algorithm fundamental			
		a. Shor's algorithm			
		b. Grover Search			
		c. Berstein-Vazirani algorithm			
		d. Simon's problem			
	-	e. Deutsch-Jozsa paradigm			
	6.	Implications of quantum computing on mac	hine learning,		
		cryptography and information security			
		a. Quantum computing in machine learnin	ng: K-Means,		
	linear equations, Support Vector Machine				
	b. The basis of quantum cryptography				
	c. KSA nacking using quantum computers				
		d. Financial schemes using quantum mechan	nics		

Exams	and	assessment	Assignments, midterm assessment, and final project
formats			
Study	and	examination	The final grade is drawn from the following components:
requirem	ents		• 1 st assignment: 20% of grade
			• Midterm assessment: 20% of grade
			• 2 nd assignment: 20% of grade
			• Final project: 40% of grade
			Students must have a final grade of 61% or higher to pass this
			course.
Reading	list		 Bernhardt, C. (2019). Quantum computing for everyone. The MIT Press. Nielsen, M. A., & Chuang, I. L. (2010). Quantum Computation and Quantum Information (10th Edition). Cambridge University Press. Aaaronson, S. (2013). Quantum Computing Since Democritus. Cambridge University Press. Hidary, J. D. (2021). Quantum Computing: An Applied
			 Approach (Second Edition). Springer. Johnston, E. R., Harrigan, N., & Gimeno-Segovia, M. (2019). Programming Quantum Computers (First Edition). O'Reilly Media, Inc. Mermin, N. D. (2007). Quantum Computer Science: An Introduction. Cambridge University Press.

Module designation	Advance Topics in Software Evolution			
Course Code	EF235251			
Semester(s) in which the module is taught	Even			
A Person responsible for the module	Ir. Siti Rochimah, M.T., Ph.D.			
Language	Indonesian			
Relation to curriculum	Elective			
Teaching methods	Lecture, small group discussion, project-based learn	ing		
Workload (incl. contact hours, self-study hours)	 Lectures: 3 SKS x 50 = 150 minutes (2 hours 3 per week. 	0 minutes)		
	2. Exercises and Assignments: 3 SKS x 60 = 180 hours) per week.	minutes (3		
	3. Private study: 3 SKS x 60 = 180 minutes (3 week.	hours) per		
Credit points	3 credit points (SKS)			
Required and recommended	Software Engineering (EF235103)			
prerequisites for joining the				
module				
Course Description	In this course, students will learn about definit	itions and		
	activities in the field of software evolution, a	s well as		
	techniques for doing so. At the end of the lecture, students are			
	expected to be able to bring up new thesis topics in the field of software evolution. This course also provides the latest topics			
	software evolution. This course also provides the latest topics			
	about software evolution. Students are encouraged	to publish		
	international levels	ulollal allu		
Module objectives/intended	Students are able to understand the basics of			
learning outcomes	software quality. understand software quality	PLO 3.		
6	culture, define software quality needs, and describe	PLO 9		
	software quality models.			
	Students are able to analyze and develop software	PLO 7,		
	review and audit processes.	PLO 8,		
		PLO 9		
	Students are able to analyze and develop software	PLO 7,		
	verification and validation processes, as well as	PLO 8,		
	measure software quality using certain standards.	PLO 9		

	Students are able to identify, describe, and analyze			
	software risk management based on certain PLO 7,			
	standards, as well as analyze and develop the PLO 8,			
	contents of software quality assurance plan PLO 9			
	documents.			
Content	1. Basic concepts and activities of software evolution:			
	models and evolutionary processes: type of software			
	evolution (corrective, adaptive, perspective and			
	preventive): Legacy System			
	2. Program understanding techniques and activities			
	3 Identify had smell codes and clone codes			
	4 Program refactorization			
	5 Analysis of the impact of software changes			
	6 Software repository management			
	7 Software reuse			
	8 Software crash			
	0. Software crash			
Evenue and eccentrat	9. Software reengineering			
Exams and assessment	Presentation, write and submit scientific publication			
formats				
Study and examination	I ne final grade is drawn from the following components:			
requirements	• 1 st presentation (The topic of software evolution to be			
	researched): 25% of grade			
	• 2 nd presentation (Conceptual framework of software			
	evolution research): 25% of grade			
	• 3 rd presentation (Experiment progress and drafting			
	scientific publication articles): 25% of grade			
	• Final presentation (Scientific article ready to be			
	published): 25% of grade			
	Students must have a final grade of 61% or higher to pass this			
	course.			
Reading list	1. Ralf Reussner et al., Managed Software Evolution,			
	Springer Open, 2019.			
	2. P. Tripathy and K. Naik, Software Evolution and			
	Maintenance: A Practitioner's Approach, Wiley, 2015.			
	3. Tom Mens, Serge Demeyer, Software Evolution, Springer-			
	Verlag, Berlin, 2008.			
	4. P. Grubb and A.A. Takang, Software Maintenance:			
	Concepts and Practice, 2nd ed., World Scientific			
	Publishing, 2003.			

Module designation	Advance Topics in Software Project Management			
Course Code	EF235252			
Semester(s) in which the	Even			
module is taught				
A Person responsible for the	Dr. Ir. Umi Laili Yuhana, S.Kom., M.Sc.			
module				
Language	Indonesian			
Relation to curriculum	Elective			
Teaching methods	Lecture, small group discussion, project-based lea	arning, demo,		
	problem-based learning			
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hour})$	s 30 minutes)		
self-study hours)	per week.			
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 18$	80 minutes (3		
	hours) per week.			
	3. Private study: 3 SKS x $60 = 180$ minutes	(3 hours) per		
	week.			
Credit points	3 credit points (SKS)			
Required and recommended	Software Engineering (EF235103)			
prerequisites for joining the				
module				
Course Description	The Advance Topics in Software Project Manage	ement contain		
	deepening theories related to software project management,			
	identification and analysis of problems that exist in software			
	project management and methods of solving th	em. Through		
	this course, students are invited to study and us	nderstand the		
	latest papers in the field of software project	management.		
	Lectures are delivered in class in the form	of lectures,		
	discussions, and presentations. Students are also c	conditioned to		
	be able to learn independently, understand cu	urrent papers		
	around project management, identify new problem	ns and define		
	solutions based on the methodology studied. Lea	arning is also		
	carried out in the laboratory and field to conduct	t experiments		
	from the solutions offered. Students are invited t	o write down		
	problem identification, proposed solutions and experimental			
	results in a paper that can be published in seminar	rs or journals.		
Module objectives/intended	Students are able to present the topic of software			
learning outcomes	project planning and tools in planning and	PLO 7		
	making research plans.			

	-				
	Students are able to summarize and report the				
	results of paper reviews and topic findings PLO 2				
	conducted from meetings 2 to 7.				
	Students are able to explain the progress of				
	experiments and draft scientific publication	PLO 2			
	articles in software project management.				
	Students are able to present scientific articles				
	that are ready to be published and submit to	PLO 2			
	international seminars or international journals.				
Content	1. Initiation and definition of software particular	roject scope:			
	requirements determination and negotiation	on, feasibility			
	analysis, process for reviewing and revising	requirements			
	2. Software project planning; process planning	, determining			
	deliverables, effort, schedule and cost	t estimation,			
	resource allocation, risk manageme	ent, quality			
	management, planning management				
	3. Software project enactment: implementat	ion of plans,			
	management of PL acquisition and suppl	ier contracts,			
	implementation of measurement proces	sses, process			
	monitoring, process control, reporting				
	Evaluation and review of Software projects; determine				
	satisfaction of needs, review and evaluate p	erformance			
	5. Completion of software projects; Define cl	osure, project			
	closure activities	1 0			
	6. Software engineering measurements, establish and				
	sustain measurement commitment, plan the measurement				
	process, assess the measurement process,	evaluate the			
	measurement				
	7. Software project management tools				
Exams and assessment	Assignments, quizzes, and a team-based projects				
formats					
Study and examination	The final grade is drawn from the following com	ponents:			
requirements	• Report writing and present the results of	paper reviews			
	(Software Project Management): 30% of	grade.			
	• Writing and evaluation proposal (Soft	ware project			
	development): 20% of grade.	1 5			
	• Progress experiment presentation and	write draft			
	scientific publication articles (Softw	vare project			
	management): 20% of grade.	1 J			

	 Final presentation (Scientific article ready to be published): 30% of grade Students must have a final grade of 61% or higher to pass this
	course.
Reading list	 Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK(R) Guide), 5th ed., Project Management Institute, 2013. Project Management Institute and IEEE Computer Society, Software Extension to the PMBOK® Guide Fifth Edition, Project Management Institute, 2013. R.E. Fairley, Managing and Leading Software Projects, Wiley-IEEE Computer Society Press, 2009. Sommerville, Software Engineering, 9th ed., Addison- Wesley, 2011. B. Boehm and R. Turner, Balancing Agility and Discipline: A Guide for the Perplexed, Addison-Wesley, 2002
	 Sommervine, Software Engineering, 9th ed., Addison-Wesley, 2011. B. Boehm and R. Turner, Balancing Agility an Discipline: A Guide for the Perplexed, Addison-Wesle 2003

Module designation	Advance Topics in Requirement Engineering			
Course Code	EF235253			
Semester(s) in which the	Even			
module is taught				
A Person responsible for the	Prof. Daniel Oranova Siahaan, S.Kom., M.Sc., PD.Eng.			
module				
Language	Indonesian			
Relation to curriculum	Elective			
Teaching methods	Lecture, discussion, case method brainstorming pap	per review		
Workload (incl. contact hours,	1. Lectures: 3 SKS x $50 = 150$ minutes (2 hours 3	30 minutes)		
self-study hours)	per week.			
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 180$	minutes (3		
	hours) per week.			
	3. Private study: 3 SKS x 60 = 180 minutes (3 week.	hours) per		
Credit points	3 credit points (SKS)			
Required and recommended	-			
prerequisites for joining the				
module				
Course Description	The Advance Topics in Requirement Engineering course is part of the Software Engineering family which discusses elicitation, analysis, specifications, software requirements validation, and requirements management during the software product life cycle. Researchers and industry practitioners have recognized that a software development project is very vulnerable to failure when activities related to software requirements are carried out poorly. Students will learn and analyze various elicitation techniques, analysis, specifications, validation, and management of the latest needs.			
learning outcomes	Students are able to analyze and develop software requirements elicitation techniques.	PLO 2, PLO 3, PLO 7		
		PLO 2,		
	Students are able to analyze and develop software	PLO 3,		
	requirements models.	PLO 7		
		PLO 2,		
	Students are able to analyze and develop methods $c = 1$	PLO 3,		
	for classifying software needs.	PLO 7		

	Students are able to analyze and develop software	PLO 2,			
	requirement specification methods.	PLO 3,			
	1 1	PLO 7			
	Students are able to analyze and develop software	PLO 2,			
	requirements management methods.	PLO 3,			
		PLO 7			
	Students are able to analyze and develop software	PLO 2,			
	needs verification methods.	PLO 3,			
		PLO 7			
Content	1. Elicitation of Requirements				
	2. Requirements Modelling				
	3. Classification of Needs				
	4. Requirement Specifications				
	5. Validation and Verification of Needs				
	6. Requirements Management				
Exams and assessment	Assignments, presentation, and paper review				
formats					
Study and examination	The final grade is drawn from the following compo	nents:			
requirements	• 1 st assignment (Scenario creation): 20% of grade				
	• 2 nd assignment (Requirement modelling): 10%	of grade			
	• 3 rd assignment (Requirement classification): 10)% of grade			
	• 4 th assignment (Software requirements sp	pecification			
	document): 10% of grade				
	• 5 th assignment (Requirement verification and	validation):			
	15% of grade				
	• 6 th assignment (Traceability metrics): 15% of g	grade			
	• Presentation paper review: 20% of grade				
	Students must have a final grade of 61% or higher	to pass this			
	course.				
Reading list	1. Daniel Siahaan, Analisis Kebutuhan dalam	Rekayasa			
	Perangkat Lunak, Penerbit Andi, 2011.				
	2. Karl Wiegers and Candase Hokanson,	Software			
	Requirements Essentials: Core Practices for	Successful			
	Business Analysis, Addison-Wesley Profession	nal, 2023			
	3. Karl E Wiegers and Joy Beatty, Software Red	quirements,			
	3rd Edition, Microsoft, 2012.				
	4. Ian K. Bray, An Introduction to Re	equirements			
	Engineering, Addison Wesley, 2002.				
	5. Pressman, R. S., Software Engineering: A Pr	ractitioner's			
	Approach, 8th Edition, McGraw-Hill, 2008.				

6.	IEEE Con	mputer Society,	SWEBOK v.3.0,	IEEE, 2014
7.	Annual	Conference:	International	Requirements
	Engineer	ing Conference,	IEEE	

Module designation	Advance Topics in Software Quality Assurance				
Course Code	EF235154				
Semester(s) in which the	Even				
module is taught					
A Person responsible for the	Ir. Siti Rochimah, M.T., Ph.D.				
module					
Language	Indonesian				
Relation to curriculum	Elective				
Teaching methods	Lecture, small group discussion, project-based learn	ning			
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours} 3)$	30 minutes)			
self-study hours)	per week.				
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 180$	minutes (3			
	hours) per week.				
	3. Private study: 3 SKS x $60 = 180$ minutes (3)	hours) per			
	week.				
Credit points	3 credit points (SKS)				
Required and recommended	Software Engineering (EF235103)				
prerequisites for joining the					
module					
Course Description	The purpose of this course is to provide knowledg	e about the			
	concept of quality, characteristics, and the va	lue of the			
	software, and software applications are being dev	eloped and			
	treated (maintenance). The important concept is software				
	requirement to determine the quality attributes of the	ne software.			
	Software requirements specify quality measureme	nt methods			
	and acceptance criteria to infer the level of achieve	ment of the			
	quality level of the software that had been predeter	mined.			
Module objectives/intended	Students are able to understand the basics of				
learning outcomes	software quality; understand the culture of	PLO 3,			
	software quality; defining software quality needs;	PLO 7			
	and describe models of software quality.				
	Students are able to analyze and develop software	PLO 7,			
	review and audit processes.	PLO 8,			
		PLO 9			
	Students are able to analyze and develop software	PLO 7,			
	verification and validation processes, as well as	PLO 8,			
	measure software quality using certain standards.	PLO 9			

	Students are able to identify, describe, and analyze
	software risk management based on certain PLO 7,
	standards, as well as analyze and develop the PLO 8.
	contents of software quality assurance plan PLO 9
	documents.
Content	1. Software quality basics
	2. Software quality culture
	3 Software quality requirements
	4 Software quality models and standards
	5 Software review process
	6 Software audit
	7 Software varification and validation
	2 Software quality massurement
	8. Software quality measurement
	9. Software risk management
	10. Device quality assurance plan
Exams and assessment	Presentation, write and submit scientific articles
formats	
Study and examination	The final grade is drawn from the following components:
requirements	• 1 st presentation (SQA topics to be researched): 25% of
	grade
	• 2 nd presentation (Conceptual framework from SQA
	research): 25% of grade
	• 3 rd presentation (Experiment progress and draft scientific
	publication articles): 25% of grade
	• Final presentation (Scientific article ready to be
	published): 25% of grade
	Students must have a final grade of 61% or higher to pass this
	course.
Reading list	1. C. Y. Laporte, A. April, Software Quality Assurance.
	Wilev-IEEE Press, 2018.
	2. Stephan Goericke. The Future of Software Quality
	Assurance. Springer Open. 2020.
	3. S. Naik dan P. Tripathy, Software Testing and Quality
	Assurance: Theory and Practice Wiley-Spektrum 2008
	4 G Gordon Schulmeyer Handbook of Software Quality
	Assurance 4th Edition Artech House London 2008
	5 D Galin Software Quality Assurance: From Theory to
	J. D. Gann, Sonware Quanty Assurance: From Theory to
	Implementation, Pearson Education Limited, 2004.

Module designation	Advance Topics in Text Mining	
Course Code	EF235263	
Semester(s) in which the	Even	
module is taught		
A Person responsible for	Prof. Dr. Ir. Diana Purwitasari, S.Kom., M.Sc	
the module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, project, presentation, demo	
Workload (incl. contact	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$	minutes) per
hours, self-study hours)	week.	
	2. Exercises and Assignments: 3 SKS x $60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hour	rs) per week.
Credit points	3 credit points (SKS)	
Required and	-	
recommended		
prerequisites for joining the		
module		
Course Description	The availability of text data and the need to find in	formation on
	the Internet are the basis for the need for specia	al processing
	techniques for text. Extracting unstructured data	a (text) into
	information and knowledge requires a technique c	alled Natural
	Language Processing. Starting with the basic process	needs on text
	data are searching, labeling the subject of discussion	on, extracting
	information with entity recognition, predictin	g sentiment
	influenced by user opinions or positions on is	ssues in the
	community, and identifying user profiles.	
Module	Able to understand the theory of text mining	PLO 2
objectives/intended	techniques and implement related processes using	PLO 3
learning outcomes	appropriate software tools.	1 20 5
	Able to analyze real problems, do self-learning in	
	order to adapt the latest text data mining techniques	PLO 3
	to solve problems.	
	Able to evaluate the stages of extracting text data	
	that has been designed in the scope of testing under	PLO 5
	controlled conditions.	
	Able to convey the results of implementation as a	PLO 3,
	solution to real problems that have been carried out	PLO 5

	in the form of exposure, reports or papers published		
	in international seminars or national scientific		
	journals.		
Content	1. Fundamental concepts and algorithms of NLP, Python		
	libraries for NLP, Information search		
	2. Extracting information, Named entity recognition		
	3. Author profiling		
	4. Sentiment Analysis, Topic Analysis		
	5. Transformers: Text Generation, Summarization, Question		
	Answering		
	Problem solving with NLP techniques on a limited scope		
Exams and assessment	Presentation, quizzes, and a team-based projects.		
formats			
Study and examination	The final grade is drawn from the following components:		
requirements	• 1 st quiz (Fundamental concepts and algorithms of NLP,		
	Python libraries for NLP, Information search): 10% of grade		
	• 2 nd quiz (Extracting information, Named entity recognition):		
	10% of grade		
	• 1 st project (Author profiling and Sentiment Analysis, Topic		
	Analysis): 25% of grade		
	• 2 nd project (Transformers: Text Generation, Summarization,		
	Question Answering): 25% of grade		
	• Presentation (Problem solving with NLP techniques on a		
	limited scope): 30% of grade		
	Students must have a final grade of 61% or higher to pass this		
	course.		
Reading list	1. Getting Started with Natural Language Processing, Ekaterina		
	Kochmar, Manning Publications, ISBN: 9781617296765,		
	2022		
	2. Natural Language Processing with Transformers, Lewis		
	Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly		
	Media, ISBN: 9781098103248, 2022		
	3. Real-World Natural Language Processing, Masato Hagiwara,		
	Manning Publications, ISBN: 9781617296420, 2021		
	4. Journal articles in accordance with the topic of discussion in		
	Information Processing Management		
	https://www.sciencedirect.com/journal/information-		
	processing-and-management		

Module designation	Advance Topics in Computer Vision	
Course Code	EF235264	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Prof. Dr.Eng. Nanik Suciati, S.Kom., M.Kom.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, case method, project-based le	earning
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours})$	30 minutes)
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS } x 60 = 18$	0 minutes (3
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	-	
prerequisites for joining the		
module		
Course Description	In this course, students learn and develop vision computing	
	techniques using hand-crafted and deep learning a	pproaches in
	solving a real problem and publish the results of t	heir research
	in seminars or journals at national and internation	al levels.
Module objectives/intended	Students are able to analyze the application of	PLO 2
learning outcomes	vision computing in various applications.	
	Students are able to analyze and develop image	PLO 3.
	recognition techniques using hand-crafted	PLO 5
	features.	
	Students are able to analyze and develop image	PLO 3,
	recognition techniques using deep learning.	PLO 5
	Students are able to analyze and develop image	PLO 3.
	and video recognition techniques using	PLO 5
	Sequential-based deep learning.	1200
	Students are able to analyze and develop object	PLO 3,
	detection techniques using deep learning.	PLO 5
	Students are able to analyze and develop object	PLO 3,
	segmentation techniques using deep learning.	PLO 5

		-
	Students are able to analyze and develop	PLO 3
	generative-model techniques based on deep	PLO 5
	learning.	TLO J
	Students are able to analyze and develop	
	computational vision techniques to solve real	PLO 2,
	problems and publish the results of their research	PLO 3,
	in seminars or journals at national and	PLO 5
	international levels.	
Content	1. Vision computing concepts	
	2. Image recognition with hand-crafted features	
	3. Image recognition with a deep learning appro	ach
	4. Image and video recognition with a sequentia	ll-based deep
	learning approach	
	5. Object detection	
	6. Object segmentation	
	7. Image captioning, style transfer	
Exams and assessment	Assignments, case study analysis, and a team-base	ed projects.
formats		
Study and examination	The final grade is drawn from the following comp	oonents:
requirements	 Presentation (Computer vision scientific artigrade 	cle): 25% of
	 Program Demo (Digital image classification) 	on): 25% of
	grade	
	• Project progress presentation: 25% of grade	
	• Presentation final project: 25% of grade	
	Students must have a final grade of 61% or highe	r to pass this
	course.	-
Reading list	1. Computer Vision: Algorithms and Application	ons (Texts in
	Computer Science), Richard Szeliski, 2011.	
	2. Computer Vision: Models, Learning, and	d Inference,
	Simon. J. D. Prince, 2012.	
	3. Digital Image Processing, Rafael C. Gonzalez	z, 2018.
	4. Scientific articles related to Computationa	al Vision in
	reputable international journals.	

Module designation	Advance Topics in Biomedical Computing	
Course Code	EF235265	
Semester(s) in which the	Even	
module is taught		
A Person responsible for the	Prof. Ir. Handayani Tjandrasa, M.Sc., Ph.D.	
module		
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, discussion, project	
Workload (incl. contact hours,	1. Lectures: $3 \text{ SKS x } 50 = 150 \text{ minutes} (2 \text{ hours } 30 \text{ minutes})$	
self-study hours)	per week.	
	2. Exercises and Assignments: $3 \text{ SKS x } 60 = 180 \text{ minutes} (3)$	
	hours) per week.	
	3. Private study: 3 SKS x $60 = 180$ minutes (3 hours) per	
	week.	
Credit points	3 credit points (SKS)	
Required and recommended	Computational Intelligence (EF235101)	
prerequisites for joining the		
module		
Course Description The Advance Topics in Biomedical Computing course i		
	designed to provide students with knowledge about computing	
	applied in the biomedical field. In this course, students will	
	learn and analyze various kinds of biomedical data including	
	lab result data, bio-signal data such as electrocardiogram	
	(ECG) and electroencephalogram (EEG), medical image data	
	such as X-ray, Computed Tomography (CT) scan, Magnetic	
	Resonance Imaging (MRI), and Ultrasound (USG), gene data,	
	DNA, RNA, proteins, sequence alignment, and integrated	
	medical information systems. Then students will learn how to	
	process data and use machine learning and deep learning so that	
	they can analyze and implement intelligent biomedical	
	systems.	
Module objectives/intended	Students are able to understand the recording and	
learning outcomes	analysis of bio-signal characteristics such as	
	ECG, EEG, ENG, and EMG, including PLO 2,	
	understanding blood pressure waveforms, heart PLO 5	
	sounds, and phonocardiogram frequency	
	spectrum.	

	Students are able to analyze and apply bio-signal	
	classification modeling by utilizing pre-	PLO 2,
	processing algorithms, feature extraction, and	PLO 5
	machine learning.	
	Students are able to understand medical imaging	
	instruments and their imaging results. Students	
	are able to analyze and apply filtering	
	processing, enhancement, edge detection,	
	segmentation, digital subtraction angiography	PLO 2,
	(DSA), and machine learning to model medical	PLO 5
	imaging solutions in either DICOM or other	
	formats. Students are able to understand the use	
	of deep learning for medical images.	
	Students are able to analyze and apply sequence	PLO 2,
	alignment methods to gene data.	PLO 5
	Students are able to understand and explain	
	integrated medical information systems for	PLO 2,
	processing and management of medical data.	PLO 5
Content	1. Introduction to biomedical computing, de	escription of
	biomedical data, and examples of biomedical	applications.
	2. Electrocardiography and electrocardiogram	n (ECG or
	ECG): cardiac conduction system, P wave, Q	RS, T wave,
	ECG mechanism, 12-lead ECG system, 1	normal ECG
	signal, heart rhythm.	
	3. Basic concepts of EEG, electroencephalo	graphy, The
	International 10-20 System, non-invasive,	normal and
	epileptic EEG signal recording, and Bra	in-Computer
	Interface (BCI). ENG and EMG:	biopotential,
	electroneurogram (ENG), conduction vel	locity ENG,
	action potential, electromyogram (EMG).	
	4. Blood pressure and heart sounds: cardiac	physiology,
	blood pressure, invasive and non-invasive bl	lood pressure
	measurement, blood pressure waveforms, h	neart sounds,
	auscultation techniques, stethoscope	development,
	phonocardiogram recording, heart sounds	and cardiac
	cycles, phonocardiogram frequency spectrum	m, murmurs,
	sphygmomanometer.	
	5. Bio-signal processing: noise filtering,	Independent
	Component Analysis (ICA), frequency spect	rum, wavelet
	denoising, preprocessing, feature extra	action, and

	classification. Examples of EEG classification, Brain-
	Computer Interface (BCI), functional Magnetic Resonance
	Imaging (fMRI). Examples of peak detection algorithms P,
	ORS. T on ECG signals, arrhythmia detection algorithms.
	6. Medical imaging: X-ray instruments. Computed
	Tomography (CT) scapper. Magnetic Resonance Imaging
	(MRI) ultrasound imaging Nuclear Medicine X-ray
	projection radiographic density PA vs AP terminology
	Y ray examples Y ray dose CT principles Iterative
	reconstruction method Hounsfield unit (HII) example of
	CT with 2D reconstruction Pasia physics of magnetic
	recommence imaging (MDI) contract differences for T1 and
	T2 unighted differences between MDL and CT imaging
	12 weighted, differences between MRI and CT imaging.
	Basic principles of ultrasound, examples of ultrasound
	imaging. Basic principles of nuclear medicine (nuclide
	imaging), SPECI, PEI, examples of SPECI and PEI
	imaging.
	/. Medical image processing: image database, Digital
	Imaging and Communications in Medicine (DICOM),
	DICOM data model and instances, examples of DICOM
	datasets, other imaging formats, image quality, examples
	of DICOM viewer, examples of filtering operations,
	enhancement, edge detection, segmentation, digital
	subtraction angiography (DSA), examples of classification
	with machine learning and deep learning. 3DSlicer
	application.
	8. Introduction to bioinformatics: Gene, DNA, RNA,
	protein/amino acid sequence. Computation and analysis of
	gene data, functional genomics, sequence alignment.
	9. Telemedicine and PACS: benefits, scope and use of
	telemedicine, telemedicine equipment, mobile
	telemedicine and wide area networks, Radiology
	Information System (RIS), Hospital Information System
	(HIS), Picture Archiving and Communication System
	(PACS). PACS and RIS integration
Exams and assessment	Assignments, midterm assessment, presentation and demo of
formats	final project
Study and examination	The final grade is drawn from the following components:
requirements	

	 1st assignment (Explains the mechanism for the formation of ECG signals and calculates normal and abnormal heart rates): 15% of grade 2nd assignment (Explains the electrode configuration, the formation of EEG signals, and the characteristics of normal and epileptic EEG): 15% of grade Midterm assessment: 20% of grade 3rd assignment (Problem solving for medical image cases): 20% of grade Presentation and demo of final project: 30% of grade Students must have a final grade of 61% or higher to pass this
Keading list	1. Edward C Shortlife and James J. Cimino, Biomedical Informatics: Computer Applications in Health Care and Biomedicine, 3rd ed., Spring er, 2006.
	2. Wolfgang Birkfellner, Applied Medical Image Processing, 2nd, CRC Press, Taylor & Francis Group, 2014.
	3. J. G. Webster (editor), Medical Instrumentation:
	Application and Design,4th ed., Hoboken: Wiley, 2010.
	4. Jaakko Malmivuo and Robert Plonsey,
	Bioelectromagnetism-Principles and Applications of
	Bioelectric and Biomagnetic Fields, Oxford University Press, 1995.
	5. Biomedical Computing, MIT OCW, Harvard-MIT Division of Health Sciences and Technology, 2005.
	6. Functional Magnetic Resonance Imaging - Data
	Acquisition and Analysis, MIT OCW, 2008.
	7. H. Eren and J. G. Webster (editors), Telehealth and Mobile
	Health, CRC Press, Taylor & Francis Group, 2016.
	8. W. J. Tompkins and J. G. Webster (editors), Design of
	Enclowerd Cliffe Prontice Usil 1091
	Diglewood Chills: Prenuce-Hall, 1981.
	 10 IEEE Transactions on Modical Imaging
	10. TEEE Transactions on Medical Imaging.

Module designation	Thesis - Proposal		
Course Code	EF235301		
Semester(s) in which the	3 rd		
module is taught			
A Person responsible for the	Dr. Ahmad Saikhu, S.Si., M.T.		
module			
Language	Indonesian		
Relation to curriculum	Compulsory		
Teaching methods	Supervisions/discussion, article reviews, presentat	tion	
Workload (incl. contact hours,	1. Supervised Research Activity: 3 SKS x 170 =	510 minutes	
self-study hours)	(8 hours 30 minutes) per week.		
	2. Report Writing.		
Credit points	3 credit points (SKS)		
Required and recommended	o Students have passed the Research M	Methodology	
prerequisites for joining the	(EF235201) course.		
module	• Student has completed a minimum 12 credits t	o program in	
	2 nd Semester.		
Course Description	This course aims to provide students in writing research		
	proposal and thesis development. It consists of knowledge in		
	research topic to conduct, research metho	dology and	
	development, experiment design and implement	itation using	
	the Childelines for Writing Thesis Proposels	sals refers to	
	which d by the Directorate of Destarduate or	and Reports	
	Development	lu Academic	
Module objectives/intended	Students are able to identify and compile the		
learning outcomes	background formulation and limitations of		
learning outcomes	problems goals and benefits and contributions	PLO 2	
	(novelty) of research		
	Students are able to write literature reviews.	PLO 2	
		PLO 3	
	Students are able to compile research methods		
	according to research objectives and	PLO 3,	
	contributions.	PLO 4	
	Students are able to compile a thesis proposal	PLO 2,	
	based on scientific rules, procedures, and ethics.	PLO 4	
Content	1. Excavation and exploration of research ideas	s through the	
	review of scientific articles	_	

			2. Writing research background, research gap, motivation,		
			and thesis research contribution		
			3. Review of literature relevant to the thesis research topic		
			4. Research method writing		
Exams	and	assessment	Thesis proposal report, presentation, revision, and submit final		
formats			thesis proposal report		
Study	and	examination	The final grade is drawn from the following components:		
• Material mastery: 25% of grade		• Material mastery: 25% of grade			
			• Research contribution: 30% of grade		
			• Problem complexity: 25% of grade		
			• Scientific rules: 20% of grade		
			Students must have a final grade of 61% or higher to pass this		
			course.		
Reading	list		1. Guidelines for Writing Thesis Proposals and Reports		
			published by the Directorate of Postgraduate and Academic		
			Development		

Module designation	Thesis - Scientific Publication	
Course Code	EF235302	
Semester(s) in which the	3 rd	
module is taught		
A Person responsible for the	Dr. Ahmad Saikhu, S.Si., M.T.	
module		
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Supervision/discussion, presentation	
Workload (incl. contact hours,	1. Supervised Research Activity: 3 SKS x 170 =	= 510 minutes
self-study hours)	(8 hours 30 minutes) per week.	
	2. Writing, submit, and revise a scientific article	
Credit points	3 credit points (SKS)	
Required and recommended	Thesis – Proposal (EF235301)	
prerequisites for joining the		
module		
Course Description	This course aims to provide students with knowle	dge and skills
	in writing and publishing articles from their	research and
	development at international conference or nation	nal accredited
	journal or international journal.	
Module objectives/intended	Students master the concepts of making	
learning outcomes	scientific writings ranging from abstracts,	PLO 3
	introductions, methodologies, analysis,	_
	conclusions, and bibliography.	
	Students are able to explain the novelty of the	PLO 3
	research done.	
	Students are able to understand the procedures	
	in the implementation of publication of	PLO 4
	appropriate, valid and plagiarism-free research	
	results.	
	Students are able to create scientific articles in	
	accordance with related research topics and	PLO 4
	publish in accredited national journals or	
Content	International journals.	
Content	1. Concepts and skills in reading scientific write	ngs
	2. The concept of influing noverly research from]	public articles
	4. The concept of understanding Plagiarism	
	4. The concept of making scientific writing	
	5. Publication procedure	

Exams	and	assessment	The proof of acceptance or publication of the article.	
formats				
Study	and	examination	Students must meet the following requirements to pass this	
requirements			course:	
			 Student got A grade if the scientific article has been accepted or published in Scopus-indexed international journal or accredited national journal with SINTA Score S1/S2. Student got AB grade if the scientific article has been accepted or published in an accredited national journal with SINTA Score ≥ S3, or the article has been presented in a 	
			reputable international conference.	
Reading	Reading list 1. Articles in Scientific Journals related to chosen topi		1. Articles in Scientific Journals related to chosen topics.	

Module designation	Thesis - Final Defense	
Course Code	EF235401	
Semester(s) in which the	4 th	
module is taught		
A Person responsible for the	Dr. Ahmad Saikhu, S.Si., M.T.	
module		
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Supervisions/discussion, article reviews, presenta	tion
Workload (incl. contact hours,	1. Supervised Research Activity: 6 SKS x	170 = 1020
self-study hours)	minutes (17 hours) per week.	
	2. Report Writing.	
Credit points	6 credit points (SKS)	
Required and recommended	Thesis - Proposal (EF235302)	
prerequisites for joining the		
module		
Course Description	In this course, students realize a thesis research plan based on an approved proposal, including improving the modeling	
	framework, trials/experiments, evaluating and analyzing trial	
	results, and writing a thesis research report with the supervision	
	of the supervisor. The results of the thesis research are	
	presented in the final thesis session, which is	attended by
	students, supervisors, and examining lecturers.	
Module objectives/intended	Students are able to formulate elements of	PLO 1,
learning outcomes		PLO 2,
	novelty and usefulness of thesis research.	PLO 3,
		PLO 4
	Students are able to realize the framework of research methods according to the thesis proposal.	PLO I,
		$\frac{PLO 2}{2},$
		PLO 3,
		PLO 4
	Students are able to conduct trials/experiments to validate the proposed novelty. Students are able to formulate and analyze the results of thesis research trials.	$\frac{PLO 1}{2}$
		$\frac{PLO 2}{2}$
		$\frac{PLO 3}{PLO 4}$
		PLO 1
		PIO 2
		PLO 3
		· = = 5,

		PLO 1,	
	Students are able to write thesis research reports	PLO 2,	
	based on the rules of writing scientific papers.	PLO 3,	
		PLO 4	
Content	1. Novelty and usefulness of thesis research		
	2. Research methods framework		
	3. Trials/experiments		
	4. Analysis of trial results		
	5. Writing a thesis research report		
Exams and assessment	Thesis report, presentation, revision, and submi-	t final thesis	
formats	report		
Study and examination	The final grade is drawn from the following components:		
requirements	• Material mastery: 25% of grade		
	• Research contribution: 30% of grade		
	• Problem complexity: 25% of grade		
	• Scientific rules: 20% of grade		
	Students must have a final grade of 61% or highe	r to pass this	
	course.		
Reading list	1. Guidelines for Writing Thesis Proposals	and Reports	
	published by the Directorate of Postgraduate and	nd Academic	
	Development		