MODULE HANDBOOK

MASTER OF INFORMATICS PROGRAM (MIP)

DEPARTMENT OF INFORMATICS

FACULTY OF INTELLIGENT ELECTRICAL AND INFORMATICS TECHNOLOGY

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

SURABAYA, 2022

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

The Program Learning Outcomes (PLO) of the Master of Informatics Program (MIP) are:

PLO 1.	Able to improve intelligent system concepts and computational science to produce intelligent applications in various scientific fields and disciplines
PLO 2.	Able to improve network architecture concepts and network-based computing principles with high performance and security
PLO 3.	Able to analyze and improve software with good quality both technically and managerial by using software engineering processes principles
PLO 4.	Able to model and improve computer graphics principles as well as human and computer interactions in software development
PLO 5.	Able to analyze and improve computational problem solving through modeling with exact, numerical, and probabilistic approaches effectively and efficiently.
PLO 6.	Able to improve methods for managing data and information in various forms
PLO 7.	Internalize values, norms, and academic ethics and demonstrate an independent attitude of responsibility for work in their field of expertise
PLO 8.	Able to work and communicate effectively both individually and in groups
PLO 9.	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

COURSE LIST OF MIP PROGRAM

No.	Course Code	Course Name	Credit
		SEMESTER I	
1	IF185101	Computational Intelligent	3
2	IF185102	Net-Centric Computing	3
3	IF185103	Software Engineering	3
4	IF1859xx	Elective Courses	3
		Total	**12**
		SEMESTER II	
1	IF185201	Research Methodology	3
2	IF1859xx	Elective Courses	9
		Total	**12**
		SEMESTER III	
1	IF185301	Thesis – Proposal	3
2	IF185302	Thesis – Scientific Publication	3
		Total	**6**
		SEMESTER IV	
1	IF185401	Thesis – Final Defense	6
		Total	**6**
		Number of Credits	**36**

LIST OF ELECTIVE COURSES

No.	Course Code	Course Name	Credit
1	IF185911	Advance topics in Network Design and Audit	3
2	IF185912	Advance topics in Cyber Security	3
3	IF185921	Advance topics in Modelling and Simulation	3
4	IF185922	Advance topics in Time Series Data Analysis	3
5	IF185931	Advance topics in Human and Computer Interaction	3
6	IF185932	Advance topics in Game Development, Virtual Reality, and Augmented Reality	3
7	IF185933	Advance topics in Computer Graphics	3
8	IF185941	Advance topics in Multimedia Networking	3
9	IF185942	Advance topics in Distributed Systems	3
10	IF185943	Advance topics in Digital Forensic	3
11	IF185944	Advance topics in Network Security	3
12	IF185945	Advance topics in Mobile Computing	3
13	IF185946	Advance topics in Cloud Computing	3
14	IF185947	Advance topics in Wireless Network	3
15	IF185951	Advance topics in Data Mining	3
16	IF185952	Advance topics Information Retrieval	3
17	IF185953	Advance topics Image Processing	3
18	IF185954	Advance topics Computer Vision	3
19	IF185961	Advance topics System Audit	3
20	IF185962	Advance topics Knowledge-Based Engineering	3
21	IF185963	Advance topics Geospatial Data Analysis	3
22	IF185971	Advance topics Software Evolution	3
23	IF185972	Advance topics Software Project Management	3
24	IF185973	Advance topics Requirement Engineering	3
25	IF185974	Advance topics Software Quality Assurance	3

Module designation	**Computational Intelligence**	
Semester(s) in which the module is taught	1	
A Person responsible for the module	Dr. Eng. Chastine Fatichah, S.Kom., M.Kom.	
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, Project	
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	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 Genetic Algorithm (GA), Ant Colony (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony. Reduction and transformation of data includes Principle Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Independent Component Analysis (ICA).	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO1 - Students are able to analyse data, transform data, and extract features.	PLO1
	CO2 - Students are able to analyse clustering methods and their use in an application.	PLO1
	CO3 - Students are able to analyse classification methods and their use in an application.	PLO1
	CO4 - Students are able to design optimization methods and their use in feature extraction, classification, and clustering problems.	PLO1, PLO7, PLO8
Content	1. DATA INPUT: available dataset, static data, dynamic data, machine perception, model illustration consisting of pre-processing, feature extraction, classification. 2. Bayesian classification: a review of the concept 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 Transform, Fast Fourier Transform (FFT), Discrete Time Wavelet Transform. 4. CLUSTERING: Hard clustering, vector quantization, fuzzy clustering, kernel clustering methods, hierarchical clustering, application examples. 5. FUZZY LOGIC, Approximate Reasoning: a review of the various membership functions, reasoning approach with multiple rules, Mamdani implication function. 6. Linear and nonlinear classifiers: multilayer perceptron, Radial Basis Function, ANFIS, SVM, decision tree, combination classifiers. 7. IMPLEMENTATION OF CLUSTERING METHOD AND NEURAL NETWORKS, AND ANALYSIS OF RESEARCH RELATED PAPERS. 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 formats	Assignments, quizzes, and a team-based projects.
Study and examination requirements	The final grade is drawn from the following components: • Assignments: 50% of grade • Quiz: 15% of grade • Team-based project: 35% of grade Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, 4th ed., Elsevier Inc., 2009. 2. R.O. Duda, P.E.Hart, D.G.Stork, Pattern Classification, John Wiley & Sons, Inc., 2001. 3. Amit Konar, Computational Intelligence, Springer, 2005. 4. C. H. Bishop, Pattern Recognition and Machine Learning, Springer Science, 2006. 5. Journal: a. Expert Systems with Applications, www.sciencedirect.com

	b. IEEE Intelligent Systems Magazine c. Journal of Biomedical Informatics, Elsevier 6. Simon Haykin, Neural Networks: A Comprehensive Foundation (2nd Edition), Prentice Hall, 1998. 7. Christian Blum, Daniel Merkle, Swarm Intelligence: Introduction and Applications, Springer-Verlag 200.

Module designation	**Net-Centric Computing**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Ary Mazharuddin Shiddiqi, S.Kom., M.Comp.Sc., Ph.D.	
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, Project	
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	This course is an introduction of a variety of topics related to Network-Based Computing. In this course will discuss various issues and technology trends to provide further insights and find a scientific solution to resolve the problems about Network-Based Computing.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO1 – Students are able to explain and assemble knowledge in the field of Network-Based Computing in terms of concepts, theories, and terms in a variety of supporting technologies.	PLO2
	CO2 – Students are able to provide a critical assessment of a problem in Network-Based Computing technology support.	PLO2
	CO3 – Students are capable of analysing and assessing the Network-Based Computing assistive technologies to be applied in the field of new / different.	PLO2
	CO4 – Students are able to plan/find a scientific solution to resolve the problems in the field of assistive technologies Network-Based Computing.	PLO2
Content	Discussion and introduction of technology and research in the field areas: Wireless Network, Mobile Computing, Distributed Systems, Cloud Computing, Network Security and Multimedia Network.	
Exams and assessment formats	Presentations.	
Study and examination requirements	The final grade is drawn from following components: • Presentation of 1st Topic (Mobile Computing and Wireless Networks): 25% of grade • Presentation of 2nd Topic (Distributed Systems and Cloud Computing): 25% of grade • Presentation of 3rd Topic (Network Security): 25% of grade • Presentation of 4th Topic (Multimedia Network): 25% of grade	

	Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Stallings, W., "Wireless Communications and Networking 2nd Edition", Prentice Hall, 2004. 2. Abdessalam Helal, et. Al," Anytime, Anywhere Computing, Mobile Computing Concepts and Technology", McGraw-Hill. 3. Richard Hill, "Guide to Cloud Computing, Principles and Practice", Springer. 4. Cryptography and Network Security: Principles and Practice (6th Edition) by William Stallings (Mar 16, 2013). 5. Secure Coding in C and C++ (2nd Edition) (SEI Series in Software Engineering) by Robert C. Seacord (Apr 12, 2013). 6. Coleman, D., Westcott, D., "CWNA: Certified Wireless Network Administrator Official Study Guide", Wiley Publishing Inc., 2009. 7. Schiller, J.H., "Mobile Communications 2nd Edition", Addison-Wesley, 2004. 8. Mobile Computing Principles Designing and Developing Mobile Applications with Uml and Xml and the Environment", Oxford Publisher 2002. 9. Location Management and Routing in Mobile Wireless Networks, Amitava Mukherjee, Somprakash Bandyopadhyay, Debashis Saha, Artech House Publisher. 10. Andreas Heinemann, Max Muhlhauser", Peer-to-Peer Systems and Application. 11. Mohammad Ilyas and Imad Mahgoub, Mobile Computing Handbook, Auerbach Publication. 12. George Coulouris, Distributed Systems, Concepts and Design 3rd edition Addison-Wesley, 2001. 13. Biometric Cryptography Based on Fingerprints: Combination of Biometrics and Cryptography Using Information from a fingerprint by Martin Drahansky (May 23, 2010). 14. Information Security the Complete Reference, Second Edition by Mark Rhodes-Ousley (Apr 3, 2013). 15. IEEE Transactions on Mobile Computing, IEEE. 16. Pervasive and Mobile Computing, Elsevier. 17. IEEE Transactions on Cloud Computing, IEEE. 18. IEEE Transactions on Network Science and Engineering, IEEE. 19. IEEE Transactions on Services Computing, IEEE. 20. IEEE Transactions on Parallel & Distributed Systems, IEEE.

Module designation	**Software Engineering**
Semester(s) in which the module is taught	1
A person responsible for the module	Dr. Umi Laili Yuhana, S.Kom., M.Sc.
Language	Indonesian
Relation to curriculum	Compulsory
Teaching methods	Lecture, Project
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	Software engineering study about aspects related to method in order to analyse and develop with consider the process principle of software engineering.
Module objectives/intended learning outcomes	After completing this module, a student is expected to: **CO1 -** Students are able to organize the road map of software engineering research — PLO3
Content	1. Concept and principle of Software Engineering: software concept, SDLC, types of application. 2. Software engineering approach on specific systems: real time system, client-server system, distributed system, Parallel system, web-based system, high integrity system, games, mobile computing, and domain specific (business application and scientific computing). 3. Issues of each specific system: project management effectively and efficiently, software quality, process business, software process improvement.
Exams and assessment formats	One midterm assessment, one final assessment, and assignments.
Study and examination requirements	The final grade is drawn from following components: • Assignments 75% of grade • Midterm assignment 10% of grade • Final assignment: 15% of grade Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Pressman, R.S., Software Engineering: A Practitioner's Approach, 8th Edition, McGraw-Hill, 2006. 2. Sommerville, I., Software Engineering 8th Edition, Addision Westley, 2007. 3. Articles in Scientific Journals related to Software Engineering. 4. Other supporting references are given by lecturer.

Module designation	**Research Methodology**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Dr. Ir. Joko Lianto Buliali, M.Sc.	
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Lecture, Project, Article Review	
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 research methodology or the systematic study of the stages of the scientific method in developing research. The output of this course is draft of research proposals associated with each research topic.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO1 - Students are able to apply academic values, norms, and ethics and show a responsible attitude towards work in their field of expertise independently.	PLO7
	CO2 - Students are able to work and communicate both individually and in groups.	PLO8
	CO3 - Students are able to develop logical, critical, systematic, and creative thinking through scientific research in the fields of science and technology.	PLO9
	CO4 - Students are able to use scientific principles, procedures, and ethics in the form of theses and papers that have been published in seminars or scientific journals at both national and international levels.	PLO9
Content	Research Methodology course aims to sharpen the ability to think logically, critically, systematically, and creatively through scientific research in the field of science and technology based on scientific principles, procedures, and ethics in the form of theses and papers that have been published in seminars or scientific journals both at national and international levels. international. This ability is a sharpening of the ability of lecture participants who have carried out and completed research at the previous level of education (undergraduate).	
Exams and assessment formats	Assignments and team-based projects	
Study and examination requirements	The final grade is drawn from following components: • Assignments: 75% of grade • One team-based project: 25% of grade	

	Students must have a final grade of 56% or higher to pass this course
Reading list	Guidelines for Writing Thesis Book, Curriculum Team of Informatics Department, FTEIC, ITS.

Module designation	**Thesis - Proposal**	
Semester(s) in which the module is taught	3	
A person responsible for the module	Dr. Ahmad Saikhu, S.Si., M.T.	
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Supervisions and Article Reviews	
Workload (incl. contact hours, self-study hours)	1. Supervised Research Activity: 3 SKS x 170 = 510 minutes (8 hours 30 minutes) per week. 2. Writing Report.	
Credit points	3 credit points (SKS)	
Required and recommended prerequisites for joining the module	• Student has passed Research Methodology course. • Student has completed a minimum 12 credits to program in 2nd 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 methodology and development, experiment design and implementation using relevant tools.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students can explain the motivation and research gap to gain ideas in choosing research topic.	PLO7, PLO9
	CO2 - Students can explain the purpose and importance of the chosen topic in solving problems.	PLO7, PLO9
	CO3 - Students can explain the additional value of the thesis project performed by solving problems and compared with existing solutions.	PLO7, PLO9
	CO3 - Students can explain methods used in solving problems and basic concepts related to them.	PLO7, PLO9
Content	The thesis proposal involves making a thesis proposal and presenting it in front of the examiners.	
Exams and assessment formats	Thesis proposal report and Presentation	
Study and examination requirements	Students must meet the following requirements to pass this course: • The thesis proposal has been presented in front of supervisors and examining lecturers. • The thesis proposal that has been signed by supervisors and all the examiners has been submitted to the magister academic staff.	
Reading list	Guidelines for Writing Thesis Book, Curriculum Team of Informatics Department, FTEIC, ITS.	

Module designation	**Thesis - Scientific Publication**
Semester(s) in which the module is taught	3
A person responsible for the module	Dr. Ahmad Saikhu, S.Si., M.T.
Language	Indonesian
Relation to curriculum	Compulsory
Teaching methods	Supervisions, Article Reviews, Seminar
Workload (incl. contact hours, self-study hours)	1. Supervised Research Activity: 3 SKS x 170 = 510 minutes (8 hours 30 minutes) per week. 2. Writing Article
Credit points	3 credit points (SKS)
Required and recommended prerequisites for joining the module	The proposal has been approved.
Course Description	This course aims to provide student knowledge and skills in writing and publishing article from their research and development at international conference or national accredited journal or international journal.
Module objectives/intended learning outcomes	After completing this module, a student is expected to: **CO-1** Students are able to write a scientific article according to related research topics and publish in accredited national journals or international journals. — PLO7, PLO9
Content	Writing the scientific article in accordance with related research topics and adapted to the format of articles in the intended scientific journals.
Exams and assessment formats	The proof of acceptance or publication of the article.
Study and examination requirements	Students must meet the following requirements to pass this 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 list	1. Parija, Subhash Chandra, and Vikram Kate, eds. Writing and publishing a scientific research paper. Springer, 2017. 2. Articles in Scientific Journals related to chosen topics.

Module designation	**Thesis - Final Defense**	
Semester(s) in which the module is taught	4	
A person responsible for the module	Dr. Ahmad Saikhu, S.Si., M.T.	
Language	Indonesian	
Relation to curriculum	Compulsory	
Teaching methods	Supervisions, Article Reviews	
Workload (incl. contact hours, self-study hours)	1. Supervised Research Activity: 6 SKS x 170 minutes per week. 2. Writing Report	
Credit points	6 credit points (SKS)	
Required and recommended prerequisites for joining the module	Student has passed Thesis – Proposal Course	
Course Description	This course aims to provide students in conducting research, writing research report, and oral presentation in front of board of examiners.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to develop a thesis, write a thesis report and present their thesis in front of the board of examiners.	PLO7
Content	Development of thesis according to research methodology and do writing in a thesis report and present in front of the examiner.	
Exams and assessment formats	Thesis Report and Presentation	
Study and examination requirements	Students must meet the following requirements to pass this course: • The thesis report has been presented in front of supervisors and examining lecturers. • Proof of acceptance of submission thesis report to the ITS Central Library has been submitted to the magister academic staff.	
Reading list	Guidelines for Writing Thesis Book, Curriculum Team of Informatics Department, FTEIC, ITS.	

Module designation	**Advance topics in Network Design and Audit**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Dr. Eng. Radityo Anggoro, S.Kom., M.Sc.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Students learn to analyze and design computer network with correct methodology and doing computer network audit.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to explain and arrange knowledge in the field of network design and auditing in terms of concepts, theories, and terms in various kinds of supporting technologies.	PLO2
	CO-2 Students are able to provide a critical assessment of a problem in network design and audit support technologies.	PLO2
	CO-3 Students are able to analyse and assess network design and audit support methods to be applied in new / different fields.	PLO2
	CO-4 Students are able to plan/find a scientific solution to solve problems in the field of network design and auditing.	PLO2
Content	1. REQUIREMENT ANALYSIS: User, application, device, 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 formats	1. First assignment: Discussion and presentation on the topic of reactive and proactive routing protocols. 2. Midterm Evaluation: discussion and presentation related to the topic of developing reactive and proactive routing protocols. 3. Second assignment: Discussion and presentation on the topic of position-based and hybrid routing protocols.	

	4. End of Semester Evaluation: Network design and audit papers.
Study and examination requirements	The final grade is drawn from following components: • First assignments 25% of grade • Second assignment 15% of grade • Midterm evaluation: 30% of grade • End of semester evaluation: 30% of grade Students must have a final grade of 56% or higher to pass this course.
Reading list	McCabe, J. “Network Analysis, Architecture, and Design 3rd Edition”, Morgan Kauffman, 2007.

Module designation	**Advance topics in Cyber Security**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Tohari Ahmad, S.Kom., MIT., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Computer Networks	
Course Description	Students learn, analyze, and extend techniques in the field of cyber security, and applying it for certain fields. In its process, this subject takes case studies to enrich the student's knowledge.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students understand and are able to analyze the concept of cyber security, along with factors that affect the security of the systems.	PLO 1, PLO 4
	CO-2 Students are able to analyze techniques for protecting data in various environments.	PLO2
	CO-3 Students are able to extend and implement a technique for securing data based on previous methods	PLO3, PLO9
	CO-4 Students are able to analyze the experimental results and write them in an academic report.	PLO1, PLO8, PLO9
Content	Learning, analyzing, and extending techniques in the field of cyber security, and applying it to certain fields. In its process, this subject takes case studies to enrich the student's knowledge.	
Exams and assessment formats	Team-based projects	
Study and examination requirements	The final grade is drawn from the following components: • First assignments (team-based project): 15% of grade • Second assignment (team-based project): 20% of grade • Third assignment (team-based project): 20% of grade • Fourth assignment (team-based project): 45% of grade Students must have a final grade of 56% or higher to pass this course.	
Reading list	1. Cyber Forensics: From Data to Digital Evidence (Wiley Corporate F&A) by Albert J. Marcella Jr. and Frederic Guillossou (May 1, 2012). 2. Network Forensics: Tracking Hackers through Cyberspace by Sherri Davidoff and Jonathan Ham (Jun 23, 2012).	

	3. Introduction to Security and Network Forensics by William J. Buchanan (Jun 6, 2011). 4. Digital Forensics and Cyber Crime: 4th International Conference, ICDF2C 2012, Lafayette, IN, USA, October 25-26... by Marcus K. Rogers and Kathryn C. Seigfried-Spellar (Oct 7, 2013). 5. Digital Forensics with Open-Source Tools by Cory Altheide and Harlan Carvey (Apr 28, 2011).

Module designation	**Advance topics in Modelling and Simulation**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Prof. Dr. Ir. Joko Lianto Buliali, M.Sc.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Topics in Modeling and Simulation course aims to explore the concepts of modeling, computing, and statistics to solve a variety of uncertainty system containing various probability distributions and create alternative simulation models for the problem. This course contains advanced topics of modeling and simulation, namely topics that focus on system modeling 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.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to create simulation models from problem descriptions that have more than one performance parameter	PLO 5
	CO-2 Students are able to create simulation models using simulation tools and/or programming languages to execute the simulation models created	PLO5
	CO-3 Students are able to analyze the results of simulation execution results with more than one performance parameter.	PLO8
	CO-4 Student are able to analyze papers on cutting-edge simulation topics and explain the substance	PLO8
Content	1. Modeling and simulation concepts. 2. Modeling and simulation relationship, probability distributions. 3. Input modeling, output analysis. 4. Alternative systems, simulation model analysis. *5.* Recent topics in modeling and simulation.	
Exams and assessment formats	Assignments, a team-based project, a paper analysis	

Study and examination requirements	The final grade in the module is composed of 50% case study assignments, 25% team-based project, and 25% paper analysis. Students must have a final grade of 56% or higher to pass.
Reading list	1. Banks, Jerry., John S Carson. Berry L Nelson. David M Nicol. “Discrete Event system Simulation”, 5th Edition. Pearson Education. 2010. 2. Law, Averill M., W David Kelton. “Simulation Modelling and Analysis”, 3rd Edition. McGraw Hill. New York. 2000. 3. Joko Lianto Buliali, “Dasar Pemodelan dan Simulasi Sistem”, ITSPress, Surabaya, 2013. 4. James R. Evans, David L. Olson (Author), “Introduction to Simulation and Risk Analysis”, McGraw-Hill, Ltd., 1998.

Module designation	**Advance topics in Time series Data Analysis**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Dr. Ir. Joko Lianto Buliali, M.Sc.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	This course gives knowledge and perspective about several problems representing time-series form and gives knowledge about methods used to obtain an optimal solution. Students are able to develop methods and modelling the univariate/multivariate time series data.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to show the characteristics and components of time series data	PLO5
	CO-2 Students are able to model time-series data	PLO5
	CO-3 Students are able to develop methods to process data time series effectively	PLO6
	CO-4 Students are able to work and communicate effectively both individually and in groups in modelling time series data.	PLO8
Content	1. Time series Fundamental dan Forecasting 2. Linear Processes 3. State Space Models 4. Spectral Analysis 5. Estimation Methods 6. Nonlinear Time Series 7. Prediction 8. Nonstationary Processes 9. Seasonality 10. Time Series Regression	
Exams and assessment formats	Assignments and Team-based Projects	
Study and examination requirements	The final grade in the module is composed of 25% first assignment, 25% first team-based project, 25% second assignment, 25% second team-based project. Students must have a final grade of 56% or higher to pass.	
Reading list	1. Ratnadip Adhikari, Agrawal R. K., R. K. Agrawal, *An Introductory Study on Time Series Modeling and Forecasting,* Lambert Academic Publishing GmbH KG, 2013 – 76 page.	

	2. Palma, Wilfredo, *Time Series Analysis*, John Wiley & Sons, 2016. 3. Harya Widiputra, *Multiple Time-Series Analysis and Modelling: An Adaptive Integrated Multi-Model Framework,* Lambert Academic Publishing, 2012.

Module designation	**Advance topics in Human and Computer Interaction**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Dr. Eng. Darlis Herumurti, S.Kom., M.Kom.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	This course is an introduction to research in the field of human-computer interaction (HCI). This course introduces the theory of human physiology and psychology, human-computer interaction principles, user-centered application development process, research in the field of HCI steps, and experiment and evaluation in the HCI research. Through this course, students will get the opportunity to further explore research topics for develop or evaluations in the field of HCI.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to report and discuss the latest research in the field of human-computer interaction.	PLO3
	CO-2 Students are able to understand the importance of human physiological and psychological factors and their influence on human-computer interaction.	PLO3
	CO-3 Students are able to understand the basic knowledge of the interaction between humans and computers.	PLO3
	CO-4 Students are able to apply human-computer interaction on principles, guidelines, methodologies, and techniques for the development of user-centered software or information systems.	PLO3
	CO-5 Students are able to conduct evaluations and usability studies on human-computer interaction.	PLO3
	CO-6 Students are able to provide criticism on human-computer interaction designs belonging to other people or parties.	PLO3
Content	1. Introduction of human-computer interaction and research history in the field of human-computer interaction.	

	2. Overview of human factor (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 formats	1. Participation in Class Discussions 2. First assignment: review applications the latest Human and computer Interaction 3. Second assignment: review paper on the latest Human and computer Interaction 4. One Midterm assessment 5. One Final assessment
Study and examination requirements	The final grade in the module is composed of 5% participation in class discussions, 15% first assignment, 20% second assignment, 20% midterm assessment, and 40% final assessment. Students must have a final grade of 56% or higher to pass.
Reading list	1. MacKenzie, I. Scott. Human-computer interaction: An empirical research perspective. Newnes, 2012. 2. Alan Dix, Janet E. Finlay, Gregory D. Abowd, and Russell Beale. Human-Computer Interaction (3rd Edition). Prentice-Hall, Inc., Upper Saddle River, NJ, USA. 2003. 3. Lazar, Jonathan, Jinjuan Heidi Feng, and Harry Hochheiser. *Research methods in human-computer interaction*. John Wiley & Sons, 2010.

Module designation	**Advance topics in Game Development, Virtual Reality, and Augmented Reality**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Dr. Eng. Darlis Herumurti, S.Kom., M.Kom.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	In this course, students will discuss and learn about the history and development of game technology, some popular games, also game classifications based on genres, themes, and others. The next stage will learn and analyze the game development process, theory of fun, and education values in games. Until the end of the course, students with a team will be able to implement simple educational game development. This course also discusses aspects related to the development of virtual reality and augmented reality application, input and output elements that are used in virtual reality, optical modelling to produce stereoscopic view, and virtual reality programming.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students understand the concept of making games, Virtual Reality (VR) and Augmented Reality (AR).	PLO4
	CO-2 Students are able to research and create games, VR or AR.	PLO4, PLO9
	CO-3 Students are able to analyze the test results.	PLO9
	CO-4 Students can publish their research results.	PLO9
Content	Game development theory, game development process, game design document, game middleware, edutainment, theory of fun. a. Introduction to Virtual Reality 1. History of virtual reality 2. Application of virtual reality 3. Virtual reality system 4. Virtual environment b. 3D Computer Graphics 1. 3D world and transformation, object modelling, object dynamics 2. Physical modelling 3. Collision detection, surface deformation 4. Perspective view	

	5. Stereoscopic view c. VR Hardware 1. Input devices 2. Output devices d. VR Software 1. Virtual environment construction 2. Graphics rendering 3. Interaction in virtual environment 4. Collition detection 5. Collition response 6. Force feedback 7. Haptic device e. Human Factor 1. Display and vision 2. Touch and hearing 3. Health and safety issues
Exams and assessment formats	Presentations and Team-based Projects
Study and examination requirements	The final grade in the module is composed of 20% presentation of results of first review paper, 20% first team-based project, 25% second team-based project, and 35% presentation of a research paper. Students must have a final grade of 56% or higher to pass.
Reading list	1. Arnest Adam, “Fundamentals of Game Design”, New Riders Press, 2nd Edition 2010. 2. David Michael, “Serious Games, Games that Educate, Train and Inform”, Thomson Course Tech, 2005. 3. Grigore, C Burdea & Philippe, Coiffet, “Virtual Reality Technology”, Wilye Interscience, 2003. 4. William R. Sherman, Alan B.Craig, “Understanding Virtual Reality”, Morgan-Kaufmann, Inc., 2003. 5. Theory of Fun for Game Design, Ralph Koster, 2nd Edition Nov 2013. 6. “Learning and Teaching with Computer Games”, aace.org

Module designation	**Advance topics in Computer Graphics**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Shintami Chusnul Hidayati, S.Kom., M.Sc., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	In this course, students learn the theory of curve and surface modelling, rendering techniques, visualization techniques, animation techniques, and apply them in the development of CAD systems.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to understand, explain, and analyze the concept of data flow in a graphic rendering system	PLO4, PLO8, PLO9
	CO-2 Students are able to model, analyze, and develop computer graphics applications by utilizing curves and surface modeling	PLO4, PLO8, PLO9
	CO-3 Students are able to model, analyze, and develop computer graphics applications using transformation algorithms, which include viewing models, projection models, illumination models, and hidden surfaces handling.	PLO4, PLO8, PLO9
	CO-4 Students are able to model, analyze, and develop computer graphics applications by applying effect principles, such as texture mapping, bump mapping, and anti-aliasing.	PLO4, PLO8, PLO9
	CO-5 Students are able to model, analyze, and develop applications using the principles of computer graphics and apply the principles of human and computer interaction	PLO4, PLO8, PLO9
Content	1. Curve and surface modelling 2. Scattered-data approximation 3. Modelling for curve and surface design and analysis 4. Rendering techniques 5. Animation techniques	
Exams and assessment formats	1. 1st EVALUATION: Implementing object models using curves and surface modeling. 2. 2nd EVALUATION: Reviewing the latest scientific publications related to surface and curve modeling.	

	3. 3rd EVALUATION: Review the latest publications related to object transformation. 4. 4th EVALUATION: Reviewing the latest publications regarding the application of effects to objects. 5. 5th EVALUATION: Presenting the final project which is an original idea or application development on computer graphics topics.
Study and examination requirements	The final grade in the module is composed of 20% 1st evaluation, 15% 2nd evaluation, 15% 3rd evaluation, 15% 4th evaluation, and 25% 5th evaluation. Students must have a final grade of 56% or higher to pass.
Reading list	1. Computer Animation: Algorithms and Techniques. Rick Parent, Morgan Kaufmann, Third edition 2012 2. G. Farin, *Curves and Surfaces for CAGD,* Academic Press, 1997. 3. FS Hill Jr, "*Computer Graphics using OpenGL".* 4. Proceeding of ACM SIGGRAPH.

Module designation	**Advance topics in Multimedia Networking**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Prof. Tohari Ahmad, S.Kom., MIT., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	It learns multimedia data and its format, along with the security: cryptography, steganography, and watermarking. In addition, it presents data compression and state-of-the-art multimedia network technologies. From this course, students are able to improve the multimedia networks.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to analyze the concept of multimedia networks, both in the form of text, image, audio, and video data, in terms of network and security.	PLO2
	CO-2 Students are able to develop multimedia networks in terms of network and security, either individually or in groups of teams.	PLO8
Content	1. Data format: DCT and wavelet-based systems 2. Basic of data security: cryptography, steganography, watermarking 3. Compression in multimedia data	
Exams and assessment formats	Presentations and Team-based Projects	
Study and examination requirements	The final grade in the module is composed of 25% presentations based on specific topics and 75% presented team-based projects. Students must have a final grade of 56% or higher to pass.	
Reading list	1. Image and Video Encryption: From Digital Rights Management to Secured Personal Communication (Advances in Information security) by Andreas Uhl and 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 Mario Marques da Silva (Mar 14, 2012). 4. Fundamental Data Compression by Ida Mengyi Pu (Jan 11, 2006).	

	5. Cryptography and Network Security: Principles and Practice (6th Edition) by William Stallings (Mar 16, 2013).

Module designation	**Advance topics in Distributed Systems**
Semester(s) in which the module is taught	1
A person responsible for the module	Royyana Muslim Ijtihadie, S.Kom., M.Kom., Ph.D.
Language	Indonesian
Relation to curriculum	Elective
Teaching methods	Lecture, Project
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	Network-based Computing
Course Description	Topics in Distributed Systems study aspects related to the development and management of distributed systems. This includes the basic issues in distributed systems, for example, replication, fault tolerance, consistency, scalability, isolation, privacy, and so on. Technical aspects related to the development of distributed systems are also a study of this subject such as direct/indirect communications, middleware, programming, security, distributed systems, and so on. In this course, current research issues in the development and management of distributed systems are also studied.
Module objectives/intended learning outcomes	After completing this module, a student is expected to:
	CO-1 Students are able to design, develop and analyze distributed systems with limitations and constraints that arise in realizing the goals of developing the system. — PLO2
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 space). 5. Middleware for distributed systems (middleware 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 formats	One midterm assessment, one final assessment, and group presentations

Study and examination requirements	The final grade in the module is composed of 60% group presentations, 20% midterm assessment, and 20% final assessment. Students must have a final grade of 56% or higher to pass.
Reading list	1. Coulouris, G., Dollimore, J., Kindberg, T., Blair, G., “Distributed Systems: Concepts and Design 5th Edition”, Addison-Wesley, 2011. 2. Varela, C.A., “Programming Distributed Computing Systems: A Foundational Approach”, The MIT Press, 2013.

Module designation	**Advance topics in Digital Forensic**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Hudan Studiawan, S.Kom, M.Kom, Ph.D	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Students learn concepts of digital forensics, this includes computer forensics and network forensics to improve digital forensic concepts in scientific researches.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to understand the concept of digital forensics, both computer forensics and network forensics	PLO2, PLO6
	CO-2 Students are able to understand the concepts of forensic data acquisition and forensic investigation on mobile devices.	PLO2, PLO6
	CO-3 Students are able to further develop digital forensic concepts in the form of scientific papers, and conduct evaluations, both individually and in groups in teams.	PLO6, PLO8
	CO-4 Students understand anti forensic techniques in order to find the right investigative steps.	PLO7, PLO8
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 formats	• First assignment: Team-based projects based on a case study • Second assignment: Task presentation • One midterm assessment • Third assignment: Task presentation	

	• One final assessment
Study and examination requirements	The final grade in the module is composed of 20% first assignment, 20% second assignment, 20% midterm assessment, 20% third assignment, and 20% final assessment. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Cyber Forensics: From Data to Digital Evidence (Wiley Corporate F&A) by Albert J. Marcella Jr. and Frederic Guillossou (May 1, 2012). 2. Network Forensics: Tracking Hackers through Cyberspace by Sherri Davidoff and Jonathan Ham (Jun 23, 2012). 3. Introduction to Security and Network Forensics by William J. Buchanan (Jun 6, 2011). 4. Digital Forensics and Cyber Crime: 4th International Conference, ICDF2C 2012, Lafayette, IN, USA, October 25-26… by Marcus K. Rogers and Kathryn C. Seigfried-Spellar (Oct 7, 2013). 5. Digital Forensics with Open-Source Tools by Cory Altheide and Harlan Carvey (Apr 28, 2011).

Module designation	**Advance topics in Network Security**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Tohari Ahmad, S.Kom., MIT., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	It learns concepts of network security for explore and implement data securing technique. This includes basic of computer security, some attacking methods and their countermeasures.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to analyze the concept of network security and its related factors.	PLO2, PLO9
	CO-2 Students are able to explore techniques for securing data in the networks.	PLO1
	CO-3 Students are able to extend and implement a data securing technique in detail	PLO1, PLO6, PLO9
	CO-4 Students are able to analyze the experimental results and write them in an academic report	PLO2, PLO9
Content	1. The basic concept of computer security: information security, computer network security, information 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 36erberos; federated identity 6. Types and characteristics of IDS, IPS, firewalls 7. The use of VPN, IDS, firewall, honeypot	
Exams and assessment formats	Assignments and A team-based Project	

Study and examination requirements	The final grade is drawn from following components: • First assignment: 15% of grade • Second assignment: 20% of grade • Third assignment: 20% of grade • One team-based project: 45% of grade Students must have a final grade of 56% 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 Mobile Computing**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Dr. Eng. Radityo Anggoro, S.Kom., M.Sc.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Net-Centric Computing	
Course Description	This course learn and analyzes related issues associated with the development of the system in a mobile computing environment with an understanding of the characteristics of the environment and infrastructure in which the system is located, move, or interacts. This course also studies supporting technologies and methodologies to solve problems related to the purpose of the development of the achieved system.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to implement wireless network architecture concepts to improve their performance.	PLO2
	CO-2 Students are able to solve any kind of wireless network issue.	PLO2
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 formats	One Midterm assessment and one Final Assessment.	
Study and examination requirements	The final grade in the module is composed of 50% performance on midterm exams and 50% performance on final exams. Students must have a final grade of 56% or higher to pass this course.	

Reading list	1. AbdessalamHelal, 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, SomprakashBandyopadhyay, DebashisSaha, Artech House Publisher. 4. Andreas Heinemann, Max Muhlhauser", Peer-to-Peer Systems and Application. 5. Mohammad Ilyas and ImadMahgoub, Mobile Computing Handbook, Auerbach Publication.

Module designation	**Advance topics in Cloud Computing**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Royyana Muslim Ijtihadie, S.Kom., M.Kom., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Cloud computing is the new paradigm in the information technology industry. Cloud computing technology is user-oriented in services, supplying resource computing transparently. This course discusses basic cloud technology, mechanism, architecture, and the newest research technology of cloud computing.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to describe and explain the concept of cloud computing, as well as its knowledge association, according to the definition of NIST.	PLO2
	CO-2 Students are able to provide critical 40 assessment on published papers related to cloud computing research topics.	PLO2, PLO7, PLO8
	CO-3 Students are able to provide critical 40 assessment towards real-world cases related to cloud computing.	PLO2, PLO7, PLO8
	CO-4 Students are able to express their contribution to cloud computing knowledge by documenting it in published work.	PLO2, PLO7, PLO8
Content	Introduction 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 assessment formats	Assignment Presentations based on Case Study and Scientific Article	
Study and examination requirements	The final grade in the module is composed of 18% assignment presentation of first topic, 18% assignment presentation of second topic, 18% presentation of third topic, 18% draft version of scientific article and 28% final version of scientific article. Students must have a final grade of 56% or higher to pass this course.	

Reading list	1. Thomas Erl et al, “Cloud Computing, Concepts, Technology. And Architecture”. Prentice Hall. 2. Hill et al, “Guide to Cloud Computing, Principles and Practice”. Springer. 3. George Coulouris, Distributed Systems, Concepts and Design 3rd edition Addison-Wesley, 2001. 4. Tanenbaum wet all, “Distributed Systems. Principles and Paradigms”, Prentice Hall. 5. IEEE Transactions on Mobile Computing, IEEE 6. IEEE Transactions on Cloud Computing, IEEE 7. IEEE Transactions on Services Computing, IEEE 8. IEEE Transactions on Parallel & Distributed Systems, IEEE

Module designation	**Advance topics in Wireless Network**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Ir. Supeno Djanali, M.Sc., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	This course discusses issues on wireless network, identifies and analyses the limitation of the wireless network and try to find the solution. It also discusses the future trend of wireless network.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to identify issues related to Wireless Networks: challenges, limitations and developments.	PLO2, PLO9
	CO-2 Students are able to search and analyze several topics in Wireless Networks.	PLO2, PLO9
	CO-3 Students are able to explain applications related to Wireless Networks.	PLO2, PLO9
	CO-4 Students are able to write scientific papers with topics related to wireless networks.	PLO2, PLO9
Content	1. Challenges of Wireless Network: Evolution of telecommunication system, computing, and mobile/wireless system. Mobile and wireless systems, Challenges and problems: low power, variable bandwidth, mobility, security. 2. Wireless Channel: Radio spectrum allocation and characteristic on different frequencies. Simple wireless channel model: mode of propagation, path loss, multipath fading, sources of interference, radio packet link model. Technique to overcome limited radio channel: channel coding, equalization, diversity, smart antennas. 3. Sharing Wireless Link: Sharing channel based on time, frequency and codes. Static multiple access: TDMA, FDMA, CDMA. Spread spectrum: direct sequence, frequency hopping, interference resistance, Packet-oriented MAC, hidden terminal, exposed terminal. Random-access MAC: MACA, MACAW, CSMA/CA 802.11 DCFS mode, Controlled-access MAC: 802.11 PCFS mode, Bluetooth. 4. Ad Hoc Wireless Networks - MANET: Wireless ad hoc networks, Classes of Wireless Ad Hoc Networks, Unicast Routing in MANET, Various MANET routing schemes:	

	flooding, Dynamic Source Routing (DSR), Location Aided Routing (LAR), dll. 5. Sensor Network: Networked Sensor: Centralized & Distributed Approach, Sensor Network Characteristics, Sensor Protocol.
Exams and assessment formats	Assignment Presentations based on Case Study, Team-bsed Project and Scientific Article
Study and examination requirements	The final grade in the module is composed of 15% of assignment presentation on basics wireless network, 20% assignment presentation on internet of things, 30% team-based project and 35% scientific article as the result of team-based project. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Tse, D. & Viswanath, P., Fundamentals of Wireless Communication; Cambridge University Press, 2005. 2. Rappaport, Theodore S., Wireless Communications: Principles And Practice; Prentice Hall, 1995. 3. Kasera, S. & Narang, N., 3G Mobile Networks; McGraw-Hill, 2005. 4. Journal, Paper, Proceeding from different sources.

Module designation	**Advance topics in Data Mining**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Dr.Eng. Nanik Suciati, S.Kom., M.Kom.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Computational Intelligence	
Course Description	In this course, students are able to understand basic concepts and common techniques on data mining that are cleaning data from noise, outlier, and duplication; data transformation including smoothing, normalization, and feature generating; data exploration and visualization; association rules; clustering techniques; and recommendation system application. Students are also able to learn and implement data mining techniques in a variety of data i.e. text mining, web mining, mining multimedia database, mining spatial data, mining time-series data, mining sequential data, and mining stream data.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students have capability to do pre-processing, exploration, and visualization data.	PLO1
	CO-2 Students have capability to understand basic and common theories on data mining	PLO1
	CO-3 Students have capability to apply data mining techniques in various data types on the real world	PLO1
	CO-4 Students have capability to review scientific articles on data mining that are published on international conferences or journals	PLO1
Content	1. Introduction to data mining, data mining tasks, process in data mining, data mining application, data definition, attribute types of data, data types. 2. Pre-processing data: ● Quality of data: about noise, outliers, missing values, and data duplicate ● Cleaning of data: handling noise, identification, and removal outlier, imputation techniques. ● Transformation data: smoothing, normalization, aggregation, creating feature or attribute, and generalization ● Data Reduction: dimension reduction, feature selection, data sampling	

	● Discretization data: binning, entropy-based 3. Exploration and visualization of data ● Statistic method: frequency or mode, percentile, mean and median, range and variance ● Visualization: histogram, box plot, scatter plot, contour plot, star plot, Chernoff's face 4. Association rules: association rules concepts, frequent itemset, apriori algorithm, closed itemset, FP-growth algorithm, generate rules, mining multiple minimum support 5. Clustering: clustering types, clustering algorithm (K-Means, Hierarchical, Density-based, Graph-based), validity cluster, and how to measure. 6. Recommender systems and collaborative filtering: recommendation system, recommendation types, recommendation content bases, collaborative filtering technique. 7. Text mining: information retrieval, query, model, and relevance feedback; clustering and classification document. 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. Mining time series and sequential data: time series data and sequential, analysis trend, analysis similarity, and some example application 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	One midterm assessment, one final assessment, and assignments
Study and examination requirements	The final grade in the module is composed of 30% midterm assessment, 30% final assessment, and 40% assignments. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education (Addison Wesley), 2006. 2. Jiawei Han and Micheline Kamber, "Data mining: Concepts and Techniques", Morgan Kaufmann Publishers, 2011. 3. Anand Rajaram, Jure Leskovec and Jeff Ullman, "Mining of Massive Data Sets", 4. Cambridge University Press, 2011. 5. Ian H. Witten, Eibe Frank and M. Hall Morgan Kaufmann, "Data mining – practical machine learning tools and techniques with Java implementations", 3rd edition, 2011 6. Article from journal IEEE Transactions on Knowledge and Data Engineering, IEEE Computer Society. 7. Article from journal ACM Transactions on Knowledge Discovery from Data, ACM Society.

Module designation	**Advance topics in Information Retrieval**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Dr. Diana Purwitasari, S.Kom., M.Sc.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Computational Intelligence	
Course Description	This unit explores a comprehensive knowledge of information retrieval. Students will learn text processing techniques in order to recover the information on text data. The course topics cover pre-processing, feature extraction, calculating text similarities based on input query, and visualizing search results. Other discussions are about relevance feedback, classification, and clustering of text data as users' guidance in searching the information. The students are also expected to design, analyze, and apply information retrieval methods in real-world problems and are able to develop new techniques as individual or group assignments to demonstrate teamwork skills. Furthermore, students will explore advanced topics in information retrieval fields using related scientific articles.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students can explain concepts, theories and applications in the field of information retrieval	PLO1
	CO-2 Students can implement problem solving techniques like indexing, searching, query processing in the field of information retrieval	PLO1
	CO-3 Students are able to conduct independent research on a chosen research topic, write a small research report, and give an oral presentation.	PLO1
	CO-4 Students are able to critique various methodologies for solving problems in information retrieval.	PLO1
Content	1. Information retrieval with boolean model, vector space model, and probabilistic model, lucene library, relevance feedback, web searching, classification and clustering. 2. Applications in the field of information retrieval: content-based image retrieval, latent semantic indexing, recommendation system, information extraction system. 3. Recent research in the field of information retrieval.	

Exams and assessment formats	One midterm assessment, one final assessment, and assignment presentations.
Study and examination requirements	The final grade in the module is composed of 25% midterm assessment, 25% final assessment and 50% assignment presentations. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Ricardo Baeza-Yates, Berthier Ribeiro-Neto, “Modern Information Retrieval: The Concepts and Technology behind Search 2nd Ed”, Addison-Wesley, New Jersey, 2011. 2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, “Introduction to Information Retrieval”, Cambridge University Press, 2008. 3. IEEE Transactions on Knowledge & Data Engineering. 4. ACM Transactions on Asian Language Information Processing. 5. ACM Transactions on Knowledge Discovery from Data. 6. Special Interest Group on Information Retrieval.

Module designation	**Advance topics in Image Processing**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Ir. Handayani Tjandrasa, M.Sc., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Computational Intelligence	
Course Description	1. Students learn about digital images pre-processing such as contrast enhancement, illumination equalization, elimination of reflections, and noise. 2. Students learn about Fourier transform, FFT, Wavelet, and Hough transform. 3. Students learn about image filtering in the frequency domain, image restoration to repair the degraded image visually or geometrically in the image registration, and the zooming process. 4. Students implement digital image preprocessing and image processing in the frequency domain and Wavelet, and analyze the related research. 5. Students learn about segmentation with various methods, which are based on boundary detection, threshold values, and regions. 6. Students learn about various methods for feature extraction as a feature vector in pattern classification. 7. Students learn about classification methods using neural networks, clustering, neuro fuzzy, Bayesian. 8. Students implement feature extraction of digital images and classification and analyze related research.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to apply digital image processing for image improvement with filters in the spatial and frequency domains and are able to apply segmentation methods, as well as feature extraction for descriptors.	PLO1
	CO-2 Students are able to understand and explain the functions of digital image processing system applications.	PLO1
	CO-3 Students are able to analyze research papers in digital image processing and get concepts and are able to design automatic digital image processing systems.	PLO1, PLO 8

	CO-4 Students are able to develop methods from research that has been done so that it has the potential to be continued as a research topic.	PLO1, PLO8
Content	1. DIGITAL IMAGE PREPROCESSING: contrast enhancement, illumination equalization, elimination of reflections, and noise. 2. IMAGE TRANSFORM: Fourier transform, Wavelet, Hough transform. 3. IMAGE FILTERING IN THE FREQUENCY DOMAIN AND RESTORATION PROCESS. 4. IMPLEMENTATION OF DIGITAL IMAGE PREPROCESSING AND ANALYSIS OF RELATED RESEARCH. 5. SEGMENTATION WITH VARIOUS METHODS: methods which based on boundary detection, threshold values, and regions. 6. FEATURE EXTRACTION METHODS: boundary descriptor, Fourier descriptor, topological descriptor, moment, texture. 7. CLASSIFICATION METHODS: neural networks, clustering, neurofuzzy, Bayesian. 8. IMAGE FEATURE EXTRACTION AND CLASSIFICATION, PAPER ANALYSIS OF RELATED RESEARCH. 9. IMPLEMENTATION OF IMAGE CLASSIFICATION MODEL IN A GROUP PROJECT. 10. ANALYSIS OF IMPLEMENTATION RESULT AND MODEL IMPROVEMENT.	
Exams and assessment formats	One midterm assessment, one final project, and presentations	
Study and examination requirements	The final grade in the module is composed of 15% presentations, 25% mid-semester assessment, and 30% final project. Students must have a final grade of 56% or higher to pass	
Reading list	1. Gonzales, R.C., and Woods, R. E., “Digital Image Processing”, Prentice-Hall, 2008. 2. Pratt, W.K., “Digital Image Processing”, John Wiley & Sons, Inc., 2007. 3. Journal: a. IEEE Transactions on Pattern Analysis and Machine Intelligence b. Medical Image Analysis, www.sciencedirect.com c. IEEE Transactions on Medical Imaging 4. Forsyth, David A., and Ponce, Jean, “Computer Vision: A Modern Approach”, 2nd Ed., Pearson Education, Inc., 2012. 5. Petrou, Maria, and Petrou, Costas, “Image Processing: The Fundamentals”, John Wiley & Sons Ltd, 2010. 6. Costaridou, Lena (Ed.), “Medical Image Analysis Methods”, Taylor & Francis Group, 2005. 7. Russ,John C., “The Image Processing Handbook”, fifth edition, CRC Press, 2007.	

Module designation	**Advance topics in Computer Vision**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Dr. Eng. Nanik Suciati, S.Kom., M.Kom.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Computational Intelligence	
Course Description	This unit explores a comprehensive knowledge about computer vision. Topics include image processing, geometry (tracking and reconstruction), and statistical methods for detection and classification. Furthermore, students will explore advanced topics in computer vision fields using related scientific articles.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to analyze the latest computer vision applications.	PLO1
	CO-2 Students are able to analyze various image processing methods.	PLO1
	CO-3 Students are able to analyze conventional-based image recognition methods.	PLO1
	CO-4 Students are able to analyze deep learning-based image recognition methods.	PLO1
	CO-5 Students are able to design computer vision applications for object detection, object tracking or action recognition problems.	PLO1, PLO7, PLO8
Content	1. Image processing: Image Pyramid, Edge Detection, Hough Transformation. 2. Physics-Based Vision: Appearance and BRDF, Photometric Stereo, Shape from Shading, Direct and Indirect Illumination. 3. Tracking and Reconstruction: Image Formation Geometry and Projection, Optical Flow, Image Alignment and Tracking, Binocular Stereo, Structured Light Range Imaging, Photo-tourism, and Internet Stereo. 4. Statistical Methods: Principal Component Analysis, Feature Detection (BLOB and SIFT), Classification. 5. Recent Research: Image-Based Rendering, Open Challenges in Computer Vision.	
Exams and assessment formats	A midterm assessment, case study analysis, and team-based project	
Study and examination requirements	The final grade in the module is composed of 10% Case Study Analysis for first assignment, 15% case study analysis of second	

	assignment, 20% midterm assessment, 25% case study analysis for third assignment, and 30% team-based project. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. David A. Forsyth dan Jean Ponce, “Computer Vision: A Modern Approach, 2nd Edition”, Prentice-Hall, 2012. 2. Christian Wöhler, “3D Computer Vision: Efficient Methods and Applications”, Springer-Verlag, Berlin Heidelberg, 2009. 3. Francisco Escolano, Pablo Suau, Boyán Bonev, “Information Theory in Computer Vision and Pattern Recognition”, Springer Verlag, London, 2009. 4. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer-Verlag, London, 2011.

Module designation	**Advance topics in System Audit**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Prof. Drs.Ec. Ir. Riyanarto Sarno, M.Sc., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	In this course students learn the concept of system audit including information technology audit, control procedures, risk management, disaster recovery plan for business continuity. The course discusses planning and implementing audit as well as the recommendation to increase the performance of the systems. The course also covers investigation, maturity evaluation and compliance evaluation in comparison with standard operating procedures and the governance.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to define information technology audit objectives and identify process and information risks related to confidentiality, integrity and availability	PLO6, PLO8, PLO9
	CO-2 Students are able to design and carry out audit processes that are suitable for enterprise needs	PLO6, PLO8, PLO9
	CO-3 Students are able to design and implement procedures and control measures to manage risk effectively	PLO6, PLO8, PLO9
	CO-4 Students are able to analyze deep learning-based image recognition methods.	PLO6, PLO8, PLO9
	CO-5 Students are able to make recommendations for improving system performance by referring to examples of best practices, standards and regulations for information technology governance	PLO6, PLO8, PLO9
Content	Planning and implementing audit processes. Investigation methods, analysis and maturity evaluation. Compliance evaluation based on the standard operating procedures. Recommendation for increasing risk management and system.	
Exams and assessment formats	• First assignment: analysing existing audit articles • A midterm assessment • Second assignment: drafting an audit article	

	• A final project: finalizing an audit article
Study and examination requirements	The final grade in the module is composed of 20% first assignment, 20% midterm assessment, 30% second assignment and 30% final project. Students must have a final grade of 56% 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. Simha R. Magal, Integrated Business Processes with ERP Systems, John Wiley & Sons, Inc., 2012. 4. Riyanarto Sarno & Irsyat Iffano, Sistem Manajemen Keamanan Informasi, ITS Press, 2009. 5. ISO, Information Technology – Security Techniques – Information Security Management Systems ISO/IEC 27001:2005, Switzerland, 2005. 6. ISACA, The IT Governance Institute, COBIT 5, USA, 2012.

Module designation	**Advance topics in Knowledge Based Engineering**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Ratih Nur Esti Anggraini, S.Kom, M.Sc., Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	This course learns the concepts and steps in knowledge engineering, knowledge representation of the real problem analysis in the field of knowledge engineering, design models, implementation of knowledge engineering into computer system either independently or in teamwork and explore the advance related topics and able to define research topics in knowledge engineering.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students understand various types of knowledge-based systems engineering activities as well as introduction to knowledge-based systems	PLO1, PLO6
	CO-2 Students are able to carry out the knowledge acquisition process and represent the results	PLO6, PLO8, PLO9
	CO-3 Students are able to engineer knowledge-based systems using one type of knowledge-based system	PLO1, PLO6, PLO8
	CO-4 Students are able to analyze the results of knowledge-based systems engineering and put them into scientific reports	PLO8, PLO9
Content	1. Introduction to Knowledge Engineering; Data, information and knowledge, knowledge gathering techniques, knowledge modelling techniques. 2. Knowledge acquisition; definition of knowledge acquisition, methods and techniques for acquiring knowledge, recent research in knowledge acquisition. 3. Knowledge validation; definition, parameter and validation measurement process and recent research in knowledge validation. 4. Knowledge representation: definition, knowledge engineering process, knowledge engineering techniques, and recent research related to knowledge representation. 5. Inference, explanation & justification.	

	6. Semantic web; semantic web roadmap, ontology, and knowledge representation on semantic web, semantic web education. 7. Paper discussion with related topics.
Exams and assessment formats	• First assignment: Scientific Articles Analysis • Second assignment: Knowledge Acquisition • Third assignment: Paper Design • Final Project: Scientific Article
Study and examination requirements	The final grade in the module is composed of 20% first assignment, 20% second assignment, 30% third assignment and 30% final project. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Simon Kendal and Malcolm Creen, an Introduction to Knowledge Engineering, Springer, 2006. 2. R.J. Brachman and H.J. Levesque, Knowledge Representation and Reasoning, Elsevier 2004. (chapter 1-7) 3. Segaran, Evans, and Taylor, Programming the Semantic Web, O'Reilly, 2009. 4. P. Jackson, Introduction to Expert Systems, Addison-Wesley, 1999. 5. Jeffrey T Pollock, Semantic Web for Dummies, Wiley Publishing, Inc., 2009. 6. Devedziq, Vladan, Semantic Web and Education (Integration Series in Information System), Springer-Verlag, 2006. 7. Related paper will be given in the class.

Module designation	**Advance topics in Geospatial Data Analysis**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Dr. techn. Ir. Raden Venantius Hari Ginardi, M.Sc.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	This course learns the basics of earth modelling and geospatial data processing, spatial data analysis to make decisions, and Developing Location-based services.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students understand the basics of earth modelling and geospatial data processing.	PLO6
	CO-2 Students are able to analyze spatial data to make decisions.	PLO7, PLO8
	CO-3 Students are able to develop Location-based services.	PLO7, PLO8
Content	1. Map Projection and Coordinate System Analysis 2. Map digitizing Analysis 3. GPS Analysis 4. Remote Sensing – Thematic Map Analysis 5. Spatial Analysis 6. 3-D Analysis 7. Community-Based Mapping Analysis 8. Location-based Services Analysis	
Exams and assessment formats	Presentations, team-based project, and case study analysis	
Study and examination requirements	The final grade in the module is composed of 20% team-based projects and presentations, 25% case study analysis and presentations, 55% research report in the form of team-based project. Students must have a final grade of 56% or higher to pass this course.	
Reading list	1. Longley, P.A., Goodchild, M.F., Maguire, D.J., and Rhind, D.W., 2011, Geographic Information Systems and Science, New York, John Wiley & Sons. 2. Narayan Panigrahi, Computing in Geographic Information System, CRC Press, 2014 3. Quantum GIS, online resources (www.qgis.org) 4. OpenStreetMap, online resources 5. Google Map API, online resources	

Module designation	**Advance topics in Software Evolution**	
Semester(s) in which the module is taught	1	
A person responsible for the module	Ir. Siti Rochimah, M.T., Ph.D	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Student will learn about the definition and activities in the field of software evolution, as well as the techniques to working on it. At the end of this course, students are expected to bring a new research topic in software evolution.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to describe the concepts related to activities, terms, techniques, and methods in software evolution expertise.	PLO3
	CO-2 Students are able to bring a new topic thesis in the field of software evolution.	PLO7
Content	1. ROAD MAP AND EMPIRICAL STUDY: history and challenge in software evolution; the similarity and difference between software evolution and software maintenance. 2. CODE CLONING: introduction to cloning; cloning types; cloning sources; cloning evolution, clone detection and management; clone removal techniques, clone algorithm and development. 3. SOFTWARE REPOSITORIES: introduction to software repositories and software repository analysis; 57elease history. 4. FAULT PREDICTION: predict fault from history and log in software development; the cause of defect-prone software, software metrics; the techniques to predict fault using code churn, related issues; the threats to validity. 5. REFACTORING: refactoring techniques, bad smell code removal, the advantages, risks, and refactoring cost. 6. Recent research topics, e.g: software engineering pattern. 7. Exploration and enhancement in the research topics.	
Exams and assessment formats	A midterm assessment, a final assessment, presentations	
Study and examination requirements	The final grade in the module is composed of 25% midterm assessment, 50% presentations, 25% final assessment, Students must have a final grade of 56% or higher to pass this course.	

Reading list	1. Tom Mens dan Serge Demeyer, Software Evolution, Springer-Verlag, Berlin, 2008. 2. Stephan Diehl, Software Visualization: Visualizing the Structure, Behaviour, and Evolution of Software, Springer-Verlag, Berlin, 2007. 3. Nazim H. Madhavji, Juan Fernandez-Ramil, dan Dewayne Perry, Software Evolution and Feedback: Theory and Practice, John Wiley & Sons, England, 2006. 4. J. Fernandez-Ramil et al., Empirical Studies of Open Source Evolution. 5. R. Koschke, Identifying and Removing Software Clones. 6. E. Duala-Ekoko and M.P. Robillard, Tracking Code Clones in Evolving Software, In Proceedings of the 29th International Conference on Software Engineering. 7. Z. Li and Y. Zhou, PRMiner: Automatically Extracting Implicit Programming Rules and Detecting Violations in Large Software Code. Software Engineering Notes, 2005. 8. S. Hangal and M.S. Lam, Tracking Down Software Bugs Using Automatic Anomaly Detection. In Proceedings of the 24th International Conference on Software Engineering, 2002. 9. D'Ambros et al., Analyzing Software Repositories to Understand Software Evolution.

Module designation	**Advance topics in Software Project Management**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Prof. Drs.Ec. Ir. Riyanarto Sarno, M.Sc.,Ph.D.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Topic on Software Project Management contains the theory related to software project management, identification and analysis of existing problems in software project management and completion method. Through this course, students will learn and understand the lates papers in the field of project management software. Lectures delivered in the classroom in the form of lectures, discussions, and presentations. Students are also conditioned to be able to learn independently, to understand current paper about project management, identify new problems and define solutions-based methodologies are studied. Learning is also performed in the laboratory or the field to conduct experiments on the solutions offered. Students are invited to write down the identification of problems, proposed solutions and experimental results in a paper to be published in conferences or journals.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to analyze business & resource problems, risks, and technology problems and are able to assess the qualifications of team members and give appropriate assignments.	PLO3, PLO8, PLO9
	CO-2 Students are able to iteratively plan software development, plan budgets and control costs.	PLO3, PLO8, PLO9
	CO-3 Students are able to communicate well and are able to work in teams.	PLO3, PLO8, PLO9
	CO-4 Students are able to know the legal aspects related to the project, manage changing requirements, evaluate project progress and control the project.	PLO3, PLO8, PLO9
Content	1. Initiation and scope definition software projects: determination and negotiation needs, feasibility analysis, a process to review and revise the needs. 2. Planning software projects; planning process, determining deliverables, effort, schedule and cost estimates, resource	

	allocation, risk management, quality management, management planning. 3. Software project enactment: the implementation of the plan, the acquisition of software management and supplier contracts, implementation of process measurement, processes monitoring, process control, reporting. 4. Evaluation and review software projects; determine the satisfaction of needs, review and evaluation of performance. 5. Measurement of software engineering; establish and sustain measurement commitment, planning the measurement process, assess the measurement process, evaluate measurement. 6. Software project management case tool.
Exams and assessment formats	Take-home assignments, a Midterm Assessment, a Final Assessment
Study and examination requirements	The final grade in the module is composed of 50% assignments, 20% midterm assessment, and 30% final assessment. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOKI Guide), 5th ed., Project Management Institute, 2013. 2. Project Management Institute and IEEE Computer Society, Software Extension to the PMBOK® Guide Fifth Edition, Project Management Institute, 2013. 3. R. E. Fairley, Managing and Leading Software Projects, Wiley-IEEE Computer Society Press, 2009. 4. I. Sommerville, Software Engineering, 9th ed., Addison-Wesley, 2011. 5. B. Boehm and R. Turner, Balancing Agility and Discipline: A Guide for the Perplexed, Addison-Wesley, 2003.

Module designation	**Advance topics in Requirement Engineering**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Daniel Oranova Siahaan, S.Kom., M.Sc., PDEng.	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	Requirement engineering study related aspects of the approach, methods, frameworks, and requirements engineering tools that can help to solve given real problem.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to develop approaches, methods, frameworks, and requirement engineering tools can help to solve a given real problem.	PLO3
	CO-2 Students are able to communicate well and are able to work in teams.	PLO3, PLO8
Content	1. Concept and principal requirement engineering of software: requirement engineering concept, functional/non-functional requirements, types of stakeholders. 2. ELICITATION: methods, approaches, frameworks, and elicitation technology needs, as well as the latest issues and research. 3. MODELING: methods, models, tools, and modelling technology needs, as well as the latest issues and research. 4. SPECIFICATIONS: methods, models, tools, and technology requirements specification, as well as the latest issues and research, 5. VERIFICATION AND VALIDATION OF REQUIREMENT SPECIFICATIONS: methods, models, tools, and technologies of verification and validation requirements, as well as the latest issues and research.	
Exams and assessment formats	• presentations • software requirement specification report proposal	
Study and examination requirements	The final grade is drawn from following components: • Presentations: 35% of grade • Software requirement specification report: 15% • Draft proposal: 30% of grade • Final proposal: 20% of grade	

	Students must have a final grade of 56% or higher to pass this course.
Reading list	1. Daniel Siahaan, “Rekayasa Kebutuhan”, Penerbit Andi, 2012. 2. Articles from journals and conferences on Software Requirement Engineering fields. 3. Other references given during lecturer.

Module designation	**Advance topics in Software Quality Assurance**	
Semester(s) in which the module is taught	2	
A person responsible for the module	Ir. Siti Rochimah, M.T, Ph.D	
Language	Indonesian	
Relation to curriculum	Elective	
Teaching methods	Lecture, Project	
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	
Required and recommended prerequisites for joining the module	Software Engineering	
Course Description	The purpose of this course is to provide knowledge about the concept of quality, characteristics, and the value of the software, and software applications are being developed and treated (maintenance). The importance concept is software requirement to determine the quality attributes of the software. Software requirements specify quality measurement methods and acceptance criteria to infer the level of achievement of the quality level of the software that had been predetermined.	
Module objectives/intended learning outcomes	After completing this module, a student is expected to:	
	CO-1 Students are able to find and identify current issues and problems that still exist/emerge and are still challenging in at least one of the domains of software quality assurance: testing (types, levels, techniques, artifacts), standards, metrics, error estimation, testing tools, etc.	PLO3
	CO-2 Students are able to formulate core problems in one of the chosen domains, and write hypotheses and descriptions of solutions in the proposed conceptual framework.	PLO3, PLO8
	CO-3 Students are able to conduct initial experiments to support hypotheses, use datasets that have been prepared, analyze the results of initial experiments, and conclude proposed solutions in the form of scientific articles.	PLO8, PLO9
	CO-4 Students are able to summarize the results of experiments and research in the form of scientific articles (hypothesis articles/position papers) that are ready to be published in international journals, international conferences, or national journals.	PLO7, PLO9
Content	● The basics of software quality ○ Ethics and culture software ○ Value and cost of software quality ○ Characteristics and quality of software models	

	○ Improvement of the quality of the software ○ Aspects related to software security (safety) ● Process management software quality ○ Quality assurance ○ Verification and Validation ○ Audit and review ● Practical considerations of software quality ○ The need for software quality ○ Characterization of defects (defect) ○ Engineering SQM (software quality management) ○ Measurement of software quality ● Kakas assistive software quality ● Standard measurement and software quality ● Metrics of software quality ● The cost of quality and cost estimation software ● Completion of software quality ● Other topics relevant to software quality assurance.
Exams and assessment formats	• First Presentation (Team-based Project) • Midterm Assessment: Presentation • Second Presentation (Experiment Progress Presentation) • Final Assessment: Final Presentation
Study and examination requirements	The final grade in the module is composed of 25% first presentation, 255 midterm assessment, 25% second presentation, and 25% final assessment. Students must have a final grade of 56% or higher to pass this course.
Reading list	1. S. Naik and P. Tripathy, Software Testing and Quality Assurance: Theory and Practice, Wiley-Spektrum, 2008. 2. S.H. Kan, Metrics and Models in Software Quality Engineering, 2nd ed., Addison-Wesley, 2002. 3. D. Galin, Software Quality Assurance: From Theory to Implementation, Pearson Education Limited, 2004. 4. J.W. Moore, The Road Map to Software Engineering: A Standards-Based Guide, Wiley-IEEE Computer Society Press, 2006. 5. IEEE Std. 12207-2008 (a.k.a. ISO/IEC 12207:2008) Standard for Systems and Software Engineering—Software Life Cycle Processes, IEEE, 2008. 6. ISO 9000:2005 Quality Management Systems—Fundamentals and Vocabulary, ISO, 2005. 7. IEEE Std. 1012-2012 Standard for System And Software Verification and Validation, IEEE, 2012. 8. IEEE Std. 1028-2008, Software Reviews and Audits, IEEE, 2008. 9. Newest articles of Software Quality on IEEE, ACM, Elsevier, etc.