MODULE HANDBOOK

BACHELOR OF INFORMATICS PROGRAM (BIP)
DEPARTMENT OF INFORMATICS

FACULTY OF INTELLIGENT ELECTRICAL AND INFORMATICS TECHNOLOGY
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

DETERMINATION OF GRADUATED LEARNING OUTCOMES
BACHELOR OF INFORMATICS PROGRAM (BIP)
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

The Program Learning Outcomes (PLO) of the Bachelor of Informatics (BIP) Program:

PLO 1	Able to design and develop applications by applying the principles of intelligent systems and computational science to produce applications in various fields.
PLO 2	Able to apply network architecture concepts and network-based computing principles with high performance and security
PLO 3	Able to design and develop software with good quality both technically and managerially using the principles of software engineering processes
PLO 4	Able to design, model, and develop applications using computer graphics and human and computer interaction principles
PLO 5	Able to solve computational problems and mathematical modeling through exact, numerical, and probabilistic approaches effectively and efficiently
PLO 6	Able to design and implement methods to manage data and information in various formats
PLO 7	Able to design and apply algorithms in programming to solve computational problems effectively and efficiently
PLO 8	Able to show attitude: religious, disciplined, responsible, upholding human values, mutual respect, and law-abiding in the life of society, nation and state based on Pancasila (The Five Principles) values
PLO 9	Able to work and communicate effectively both individually and in groups
PLO 10	Able to understand and apply science in the context of information technology-based entrepreneurship in his expertise based on scientific principles, procedures, and ethics to produce solutions, ideas, designs, or art criticisms to be able to compete at national and international levels

COURSE LIST OF BACHELOR PROGRAM

No	Course Code	Course Name	Credit
SEMESTER: 1			
1	UG184911	Pancasila	2
2	UG184912	Bahasa Indonesia	2
3	KM184101	Math 1	3
4	SF184101	Physics 1	4
5	SK184101	Chemistry	3
6	IF184101	Fundamental Programming	4
		Total Credits	**18**
SEMESTER: 2			
1	UG184914	English	2
2	UG18490X	Religion	2
3	UG184913	Kewarganegaraan	2
4	KM184201	Math 2	3
5	SF184202	Physics 2	3
6	IF184201	Digital System	3
7	IF184202	Data Structure	3
		Total Credits	**18**
SEMESTER: 3			
1	IF184301	Object-Oriented Programming	3
2	IF184302	Linear Algebra	3
3	IF184303	Numerical Computation	3
4	IF184304	Discrete Mathematics	3
5	IF184305	Computer Organization	3
6	IW184301	Database System	4
		Total Credits	**19**
SEMESTER: 4			
1	IF184401	Design and Analysis Algorithms	4
2	IF184402	Operating System	4
3	IF184403	Artificial Intelligence	3
4	IF184404	Database Management	3
5	IF184405	Probability and Statistic	3
6	IF184406	Analysis and Design of Information Systems	3
		Total Credits	**20**

No	Course Code	Course Name	Credit
SEMESTER: 5			
1	IF184501	Software Design	3
2	IF184502	Computer Graphics	3
3	IF184503	Computational Intelligence	3
4	IF184504	Web Programming	3
5	IF184505	Computer Networks	4
6	IF184506	Software Project Management	3
		Total Credits	**19**
SEMESTER: 6			
1	IF184601	Human and Computer Interaction	3
2	IF184602	Network Programming	3
3	IF184603	Requirement Engineering	3
4	IF184604	Graph Theory and Automata	3
5	IF184605	Framework-based Programming	3
6		Elective Course 1	3
		Total Credits	**18**
SEMESTER: 7			
1	UG184915	Technopreneurship	2
2	IF184701	Information and Network Security	3
3	IF184702	Undergraduate Pre-Thesis	3
4		Elective Course 2	3
5		Elective Course 3	3
6		Elective Course 4	3
		Total Credits	**17**
SEMESTER: 8			
1	IF184801	Internship	2
2	IF184802	Undergraduate Thesis	4
3	UG184916	Scientific and Application Technology	3
4		Course for Specific Purpose	3
5		Elective Course 5	3
		Total Credits	**15**

LIST OF ELECTIVE COURSES

No	Course Code	Course Name	Credit
1	IF184901	Mobile Device Programming	3
2	IF184902	Development and Analysis Algorithm	3
3	IF184903	Interface Programming	3
4	IF184911	Wireless Networking	3
5	IF184912	Internetworking Technology	3
6	IF184913	Security Design of System and Network	3
7	IF184914	IoT Technology	3
8	IF184921	Modeling & Simulation	3
9	IF184922	Multivariate Data Analysis	3
10	IF184923	Operational Research	3
11	IF184931	Game Development Techniques	3
12	IF184932	Virtual and Augmented Reality	3
13	IF184933	Game System	3
14	IF184934	Computer Animation and 3D Modeling	3
15	IF184935	Intelligence Game	3
16	IF184941	Multimedia Network	3
17	IF184942	Cloud Computing	3
18	IF184943	Mobile Computing	3
19	IF184944	Distributed System	3
20	IF184945	Digital Forensic	3
21	IF184946	Grid and Parallel Computing	3
22	IF184947	Pervasive Computing and Sensor Network	3
23	IF184948	Data Compression	3
24	IF184951	Data Mining	3
25	IF184952	Digital Image Processing	3

26	IF184953	Biomedical Computing	3
27	IF184954	Robotics	3
28	IF184955	Information Retrieval	3
29	IF184956	Computer Vision	3
30	IF184957	Social Network Analysis	3
31	IF184958	Deep Learning	3
32	IF184961	Enterprise Systems	3
33	IF184962	Knowledge Engineering	3
34	IF184963	Systems Audit	3
35	IF184964	Information Technology Governance	3
36	IF184965	Distributed Databases	3
37	IF184966	Big Data	3
38	IF184967	Geographic Information System	3
39	IF184971	Software Architecture	3
40	IF184972	Software Quality Assurance	3
41	IF184973	Software Evolution	3
42	IF184974	Software Construction	3

Course: Pancasila (UG 184911)

MATA KULIAH ***COURSE***	**Nama Mata Kuliah** ***Course Name***	:Pancasila
	Kode MK ***Course Code***	: UG 184911
	Kredit / ***Credits***	: 2 sks
	Semester	: I / II

DESKRIPSI MATA KULIAH
Description of Course

Mata Kuliah Pancasila merupakan salah satu mata kuliah wajib umum/nasional. Dalam perkuliahan ini mahasiswa akan mendapatkan pengetahuan dan pengalaman belajar untuk meningkatkan pemahaman dan kesadaran tentang: rasa kebangsaan dan cinta tanah air melalui wawasan tentang Pancasila sehingga menjadi warganegara yang memiliki daya saing, serta berdisiplin tinggi dan berpartisifasi aktif dalam membangun kehidupan yang damai berdasarkan sistem nilai Pancasila. Setelah perkuliahan ini diharapkan mahasiswa mampu mewujudkan diri menjadi warga negara yang baik yang mampu mendukung bangsa dan negaranya. Warga negara yang cerdas, berkeadaban dan bertanggung jawab bagi kelangsungan hidup negara Indonesia dalam mengamalkan kemampuan ilmu pengetahun, teknologi dan seni yang dimilikinya.

This course provides knowledge of Pancasila, understand and examine experiences related to the application of Pancasila into human lives. This course uses a various range of teaching methods, including classroom and practical learning, learning through community engagement, seminars, interactive discussion and group works. It aims to equip students with the capacities to understand Pancasila from multi-perspective: Pancasila within Indonesia's historical context, Pancasila as a national ideology, Pancasila as a national principle, Pancasila viewed from ethical and philosophical contexts and Pancasila as the basis of science, technology and art development. This topic is also designed to improve students' ethical behavior and personality as well as grow and build nationalism values and a sense of patriotism

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH
Learning Outcome

1. Berpartisipasi dalam pembangunan bangsa sebagai warga negara Indonesia yang memiliki rasa patriotisme, tanggung jawab yang tinggi terhadap bangsa dan menumbuhkan rasa bangga dan memiliki
2. Menghormati dan menghargai keragaman budaya, kepercayaan, agama, ide dan inovasi
3. Mematuhi peraturan hukum dan melakukan perilaku disipliner dalam kehidupan bermasyarakat dan berbangsa

1. *Participating in the nation's development as Indonesia citizens who possess a sense of patriotism, high responsibility to the nation and develop a sense of pride and belonging*
2. *Respecting and appreciating cultural, beliefs, religions, ideas and innovation diversities*
3. *Obeying law orders and performing disciplinary behavior within social and national life*

CAPAIAN PEMBELAJARAN MATA KULIAH *Course Learning Outcome*

1. Percaya kepada Tuhan, menaati perintah-Nya, mengembangkan dan melakukan sikap religius
2. Menghormati dan mengedepankan nilai-nilai humaniora dalam setiap perilaku dan tanggung jawabnya atas dasar agama, moralitas dan etika
3. Berkontribusi pada peningkatan kualitas masyarakat dan pembangunan kehidupan bangsa dan peradaban yang berlandaskan Pancasila
4. Bekerja sama dan mengembangkan kesadaran sosial serta kepedulian dan kepedulian masyarakat dan lingkungan
5. Bekerja sama untuk memaksimalkan potensi

1. *Believing in God, obeying His orders, developing and performing religious attitude*
2. *Respecting and prioritizing humanities values within all of his/her conduct and responsible duty on the basis of religion, morality and ethic*
3. *Contributing to improvement of quality community and national life and civilization development on the basis of Pancasila*
4. *Cooperating and developing social awareness as well as community and environment care and concern*
5. *Cooperating to maximize potency*

POKOK BAHASAN
Main Subject

- Urgensi Pendidikan Pancasila di Indonesia
- Pancasila dalam Perspektif Sejarah Bangsa Indonesia
- Pancasila sebagai Dasar Negara Republik Indonesia
- Pancasila sebagai Filsafat dan Ideologi negara
- Pancasila sebagai Sistem Etika serta implementasi sila-sila Pancasila
- Pancasila sebagai Nilai Dasar Pengembangan Sains dan teknologi di Indonesia

- *The urgency of Pancasila in higher education*
- *Pancasila and Indonesia history*
- *Pancasila as the Indonesia national principle and national ideology*
- *Pancasila as philosophy system*
- *Pancasila as ethic system*
- *Pancasila as the foundation of science, technology and art development*

PRASYARAT
Prerequisites

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PUSTAKA
References

1. Bahar, Saafroedin (ed). 1992. *Risalah Sidang Badan Penyelidik Usaha-Usaha Persiapan Kemerdekaan Indonesia (BPUPKI): Panitia Persiapan Kemerdekaan Indonesia (PPKI) 29 Mei – 19 Agustus 1945*. Jakarta: Sekretariat Negara Republik Indonesia.
2. Bertens, Kees. 2004. *Etika.* Jakarta: Gramedia.
3. Friedman, Thomas. 2006. The World is Flat: Sejarah Ringkas Abad ke 21. Jakarta: Dian Rakyat
4. Kattsof, Louis O. 1992. *Pengantar Filsafat.* Yogyakarta: Tiara Wacana.
5. Latif, Yudi. 2011. *Negara Paripurna*, Jakarta: PT. Gramedia Pustaka Utama.
6. Latif, Yudi. 2018. *Wawasan Pancasila: Bintang Penuntun Untuk Pembudayaan.* Jakarta: Mizan.
7. Magnis-Suseno, Franz. 2006. *Etika Politik: Prinsip-prinsip Moral Dasar Kenegaraan Modern*. Jakarta: Penerbit Gramedia Pustaka Utama.
8. Schwab, Klaus. 2016. The Fourth Industrial Revolution. New York: Crown Business.
9. Sukarno. 2001. *Tjamkan Pancasila Dasar Falsafah Negara*. Jakarta: Panitia Nasional Peringatan Lahirnya Pancasila 1 Juni 1945 – 1 Juni 1964.
10. Soedarso. 2014. *Filsafat Pancasila Identitas Indonesia*. Surabaya: Pustaka Radja.

Module name	**Indonesian**	
Module level	Undergradute	
Code	UG184912	
Course (if applicable)	**Indonesian**	
Semester	Second Semester	
Person responsible for the module	ITS Indonesian Lecturer Team	
Lecturer	ITS Indonesian Lecturer Team	
Language	Indonesian	
Relation to curriculum	Undergradute degree program, **mandatory**, 2nd semester.	
Type of teaching, contact hours	Lectures, <60 students	
Workload	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.	
Credit points	2 credit points (sks)	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Learning outcomes and their corresponding PLOs	(S8) Internalizing academic values, norms and ethics (KU9) Documenting, storing, securing, and recovering data to ensure validity and prevent plagiarism. (KU1) Able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with their field of expertise.	PLO8, PLO9 PLO8, PLO9 PLO8, PLO9
Content	The Indonesian language course is one of the general / national compulsory courses. Students will explore lecture materials including: (a) academic ethics; (b) referencing techniques; (c) the systematics of KTI and the formulation of Indonesian used in KTI by taking into account the rules of grammar, PUEBI, and KBBI; (d) structuring KTI logically, critically, systematically, and innovatively by using good and correct Indonesian; (e) effective presentation techniques. The material studied is useful in	

	compiling scientific papers in the form of lecture assignments, research reports, and scientific papers that are competed.
Study and examination requirements and forms of examination	• In-class exercises (20%) • Assignment 1, 2, 3 (25%) • Mid-term examination (25%) • Final examination (30%)
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.
Reading list	Main: 1. Alwi, Hasan, 2007, Tata Bahasa Baku Bahasa Indonesia, Edisi Ketiga, Balai Pustaka: Jakarta. 2. Dirjen Pembelajaran dan Kemahasiswaan Kemenristekdikti, Bahasa Indonesia untuk Perguruan Tinggi, 2016, Jakarta, Dirjen Belmawa. 3. Kamus Besar Bahasa Indonesia (daring atau luring), Kemdikbud RI, https://kbbi.kemdikbud.go.id/ 4. Pedoman Umum Ejaan Bahasa Indonesia (PUEBI), 2016, http://badanbahasa.kemdikbud.go.id/lamanbahasa/sites/default/files/PUEBI.pdf Supporting: 1. Pratapa, Suminar, 2018, Etika ilmiah, Hak cipta, dan Plagiarisme. 2. Rosmawaty, 2017, Menulis Karya Ilmiah, 2017. 3. The Structure, Format, Content, and Style of a Journal-Style Scientific Paper, Bates Collage, http://jrtdd.com/wp-content/uploads/2018/05/Howto-Write-a-Paper-in-Scientific-Journal-Style-and-Format.pdf

Module name	**CHEMISTRY 1**	
Module level	Undergradute	
Code	SK184101	
Course (if applicable)	Chemistry 1	
Semester	First/Second Semester	
Person responsible for the module	Zjahra Vianita Nugraheni, S.Si., M.Si.	
Lecturer	ITS Chemistry Lecturer Team	
Language	Bahasa Indonesia	
Relation to curriculum	Undergradute degree program, **mandatory**, 1st/2nd semester.	
Type of teaching, contact hours	Lectures, <60 students	
Workload	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.	
Credit points	3 credit points (sks)	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Learning outcomes and their corresponding PLOs	Course Learning Outcome (CLO) after completing this module: CLO 1 Students are able to use the basic principles of chemistry as a basis for studying science related to chemistry. CLO 2 Students can perform basic chemical calculations	 PLO8, PLO9 PLO8, PLO9
Content	This course studies the basic principles of chemistry which are used as the basis for studying the next subject related to chemistry. The materials presented including atomic theory, chemical bonds, stoichiometry, state of matter and phase changes, acid-base theorem, ionic equilibrium in solution, chemical thermodynamics, chemical kinetics and electrochemistry.	
Study and examination requirements and forms of examination	● In-class exercises (20%) ● Assignment 1, 2, 3 (25%) ● Mid-term examination (25%) ● Final examination (30%)	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	
Reading list	Main :	

	1. Tim Dosen Departemen Kimia, (2019). “Kimia 1”, edisi kedua, Media Bersaudara, Surabaya. Supporting : 1. Oxtoby, D.W., Gillis, H.P. and Campion, A., (2012). ”Principles of Modern Chemistry”, 7th Edition, Brooks/Cole. 2. Chang, R. and Goldsby, K., (2012). “Chemistry”, 11th Edition, McGraw-Hill, USA. 3. Goldberg, D. E., (2007). “Fundamental of Chemistry”, 4th Edition, McGraw-Hill Companies

Module name	**Fundamental Programming**
Module level	Undergraduate
Code	IF184101
Courses (if applicable)	Fundamental Programming
Semester	1
Lecturer	Dr. Yudhi Purwananto, S.Kom., M.Kom. (PIC) Rully Soelaiman, S.Kom., M.Kom. Misbakhul Munir Irfan Subakti, S.Kom., M.Sc. Dr. Diana Purwitasari, S.Kom., M.Sc. Dr. Agus Budi Raharjo, S. Kom, M. Kom
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, lab works, project
Workload	1. Lectures: 4 sks x 50 = 200 minutes (3 hours 20 minutes) per week. 2. Exercises and Assignments: 4 x 60 = 240 minutes (4 hours) per week. 3. Private study: 4 x 60 = 240 minutes (4 hours) per week.
Credit points	4 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	-
Course description	In this course, students learn the fundamental of structured programming using C language. The fundamental of structured programming including basic problem-solving using computer approach, the basic of algorithm, and implement an algorithm using computer language, step of input-process-output, branching and looping, including their nested structures, modularity, passing parameters, recursive structure, struct, string and array data structure, handle file as input and output

Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to understand software development methodologies (analysis, design, coding, testing, documentation) and apply these methodologies to simple problems	PLO1, PLO5, PLO7, PLO9
	CO2 Able to translate designs into algorithms correctly and structured	PLO1, PLO5, PLO7, PLO9
	CO3 Able to design structured programs in a modular manner with a top-down approach using functions in C language, and able to perform debugging and testing processes	PLO1, PLO5, PLO7, PLO8, PLO9
Content	The concept of algorithms and computer programming such as: Program flowchart, standard and documentation, Application development using C language compiler, Input-process-output and data types, type cast and conversion, Control flows and their implementation example, String and array, Function, passing arguments/parameters and modularity, Recursive structure, Data Structure using Struct in C, File I/O, using graphical and other libraries, Program testing, debugging and documentation.	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, 7th edition, Addison Wesley, 2012. Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Introduction to Algorithms, McGraw-Hill, 2003

There are six religions taught according to registered religions in Indonesia. We provide a sample module handbook of Hinduism.

Module name	**Hinduism**	
Module level	Undergraduate	
Code	UG184904	
Course (if applicable)	**Hinduism**	
Semester	Second Semester	
Person responsible for the module	Dra.Ni Wayan Suarmini, M.Sc	
Lecturer	ITS Hinduism Lecturer Team	
Language	Indonesian	
Relation to curriculum	Undergradute degree program, **mandatory**, 2nd semester.	
Type of teaching, contact hours	Lectures, <60 students	
Workload	• Lectures : 2 x 50 = 100 minutes per week. • Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. • Private learning : 2 x 60 = 120 minutes (2 hours) per week.	
Credit points	2 credit points (sks)	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Learning outcomes and their corresponding PLOs	(S1) Believe in God Almighty and able to show a religious attitude (S.1); (S2) Upholding human values in carrying out duties based on religion, morals and ethics (S.2) (S6) Cooperate and have social sensitivity and concern for society and the environment (S.6) (KU.6) Able to maintain and develop cooperation networks and cooperation results within and outside the institution (KU. 6)	PLO8, PLO9 PLO8, PLO9 PLO8, PLO9 PLO8, PLO9
Content	The Hindu Religious Education course discusses and explores materials with the substance of human relations with Hyang Widdhi (God Almighty) for increased faith and piety (Sraddha and bhakti); human relations with fellow humans in building a humanist civilization; as well as human relations with their environment in creating welfare	

	(jagadhita), so as to be able to form Hindu and Indonesian human beings who are independent, responsible and caring.
Study and examination requirements and forms of examination	• In-class exercises (20%) • Assignment 1, 2, 3 (25%) • Mid-term examination (25%) • Final examination (30%)
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.
Reading list	Main: 1. Direktorat Jenderal Pembelajaran dan Kemahasiswaan, 2016, Pendidikan Agama Hindu untuk Perguruan Tinggi, Kemenristek Dikti RI Supporting: 1. Singer, Wayan, 2012. Tattwa (Ajaran Ketuhanan Agama Hindu, Surabaya, Paramita 2. Tim Penyusun, 1997, Pendidikan Agama Hindu Untuk Perguruan Tinggi, Hanuman Sakti 3. Wiana, 1994, Bagaimana Hindu Menghayati Tuhan, Manikgeni 4. Wiana, 1982, Niti Sastra, Ditjen Hindu dan Budha. 5. Titib, 1996, Veda Sabda Suci Pedoman Praktis Kehidupan, Paramita. 6. Pudja, 1997, Teologi Hindu, Mayasari

Module name	**Physics 2**	
Module level	Undergradute	
Code	SF184202	
Course (if applicable)	Physics 2	
Semester	Second Semester (Genap)	
Person responsible for the module	ITS Physics Lecturer Team	
Lecturer	ITS Physics Lecturer Team	
Language	Bahasa Indonesia	
Relation to curriculum	Undergradute degree program, **mandatory**, 2nd semester.	
Type of teaching, contact hours	Lectures, <60 students	
Workload	• Lectures : 3 x 50 = 150 minutes per week. • Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. • Private learning : 2 x 60 = 120 minutes (2 hours) per week.	
Credit points	3 credit points (sks)	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Learning outcomes and their corresponding PLOs	CLO 1 Students understand particles that compose a matter and it's electrical properties, substantial of conductor and dielectric	PLO8, PLO9
	CLO 2 Students understand the strength of an electric field based on Coulomb force and Gauss's law	PLO8, PLO9
	CLO 3 Students are able to understand various forms of electric potential in charged conductors	PLO8, PLO9
	CLO 4 Students understand the capacitance principle of various form of capacitor in capacitor circuits, series, parallel and mixed	PLO8, PLO9
	CLO 5 Able to use magnetic field force formulas for electric currents and moving charges	PLO8, PLO9
	CLO 6 Able to mention the role of magnetization in magnetic material and hysteresis loop.	PLO8, PLO9
	CLO 7 Understand the principle of electromotive force emergences, and current in resistor, capacitor and inductor	PLO8, PLO9

	CLO 8 Able to determine magnitude of the impedance, electric current and phase angle in parallel and series circuit R-L, R-C, RL-C	
Content	In this course students will learn to understand the basic laws of physics, Electric Field; Electric Potential; Electric current ; Magnetic field; Electriomotive Force (EMF) of Induction and Alternating Current, through simple math descriptions and introducing the examples of concepts usage	
Study and examination requirements and forms of examination	● In-class exercises (20%) ● Assignment 1, 2, 3 (25%) ● Mid-term examination (25%) ● Final examination (30%)	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	
Reading list	Main : 1. Halliday & Resnic; 'Fundamental of Physics'. John Wiley and Sons, New York, 1987 2. Tim Dosen, "Diktat Fisika II", ”Soal-soal Fisika II", Fisika FMIPA-ITS 3. Giancoli, DC., (terj, Yuhilza H), 'Fisika, jilid 2', Ertangga, Jakarta, 2001. Supporting : 1. Alonso & Finn,"Fundamental University Physics", Addison Wesley Pub Comp Inc,1`.ed, Calf, 1990 2. Tipler, PA,(ted. L Prasetio dan R.W.Adi), "Fisika : untuk Sains dan Teknik, Jilid 2", Erlangga, Jakarta, 1998	

Module name	**Digital System**	
Module level	Undergraduate	
Code	IF184201	
Courses (if applicable)	**Digital System**	
Semester	2	
Lecturer	Tohari Ahmad, S.Kom, M.IT, Ph.D (PIC) Prof. Ir. Supeno Djanali, MSc, Ph.D. Ir. Muchammad Husni, M.Kom Henning Titi Ciptaningtyas, S.Kom, M.Kom	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Course description	This course explains number systems, describes Boolean function of digital systems and its simplification using some methods, and explains the function and characteristic of digital system components. It also analyses and design digital systems, both combinational and sequential system.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students understand the concept of number systems, methods for simplifying Boolean functions, and logic gates.	PLO1, PLO 8, PLO9

	CO2 Students are able to design both combinational and sequential circuits for solving problems.	PLO1, PLO 8, PLO9
	CO3 Students understand the implementation of both combinational and sequential circuits, including register, counter, and memory.	PLO1, PLO 2
Content	1. Number System: Explanation between analog and digital system. Number systems: binary, octal, decimal, hexadecimal, conversion between number system. Coding: 8-4-2-1, BCD, Excess-3, Gray, dan others. 2. Boolean Algebra and simplification of Boolean function: Logic Gate: OR, AND, NOT, XOR, NAND. Truth table, logic function and its implementation using gates. SOP and POS form. Simplification using Boolean algebra & De Morgan theory. Simplification using K-map and Tabulation method. 3. Combinational Circuit: Adder, Subtractor, Decoder, Encoder, Multiplexer, Demultiplexer. Design combinational circuit. 4. Synchronous Sequential Logic: Basic concept of synchronous sequential circuit, SR Latch. SR, JK, D, and T Flip-Flops, State Diagram, Sequential circuit analysis, design using flip-flops. 5. Register, Counter and Memory: Register, Register with Parallel Load, Shift Register, Counter, Binary Up-Down Counter, Memory Decoding, memory design, Error Correction, ROM. 6. Algorithmic Satate Machine (ASM): ASM Chart, ASM Block, Timing Sequence, Circuit design using ASM Chart. 7. Asynchronous Sequential Logic (ASL): Basic concept of ASL, Transition Table, Flow Table, Race Condition. Example of ASL circuit design, simplification of State and Flow Table.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final written exam (60 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final written oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	• Supeno Djanali, Sistem Digital (Ed. 2), ITS Press, 2017. • Mano, Morris & Michael D. Cilleti, Digital Design (5th Ed). Pearson, Prentice Hall, 2013. • Wakerly, John F, Digital Design Principle & Practice (3rd. Ed). Prentice Hall, 1999 • Tan, A.T. Choy, Digital Logic Design (2nd Ed), McGraw-Hill, 2011

Module name	**Data Structure**
Module level	Undergraduate
Code	IF184202
Courses (if applicable)	**Data Structure**
Semester	2
Lecturer	Ir.F.X. Arunanto M.Sc. (PIC) Abdul Munif, S.Kom., M.Sc. Dwi Sunaryono S.Kom., M.Kom. Dr.techn. Ir.Raden Venantius Hari Ginardi M.Sc Agus Budi Raharjo, S.Kom, M.Kom., Ph.D.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, lab works, project
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Fundamental Programming
Course description	The students will learn several structures and related algorithms to organize (store, arrange, order) a data collection in a computer so that it can be used efficiently. Data abstraction is discussed in order to define a particular data structure (linear or non-linear) with some examples. Lab works with C/C++ programming language are set to implement appropriate data structure in some problem solving.

Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to abstract data on real problems according to the concept of linear data structures (stack, queue), non-linear (tree, graph) and using C/C++.	PLO6, PLO7, PLO9
	CO2 Students are able to implement data access on linear static and dynamic data structures, array and linked list, to solve the problems based on order of data entry (LIFO, FIFO) using C/C++	PLO6, PLO7, PLO9
	CO3 Students are able to explain terminology in graphs, explain and apply topological sort, find the shortest distance and minimum cost spanning tree in a graph.	PLO6, PLO7, PLO9
	CO4 Students are able to implement hash-tables, to access data based on key-value data mapping using C/C++.	PLO6, PLO7, PLO9
Content	1. Abstract data type: introduction; concepts of storing, arranging and ordering data in linear/non-linear approaches; 2. Linear data structure (stack, queue): push-pop functions in a stack; functions in a queue; empty, full, and top functions for checking the contents of a structure; implementations of stack and queue with array, linked-list and STL for problem solving; 3. Non-linear data structure - tree: functions for insertion, deletion, and searching nodes in a tree; binary search tree; graph; traversing algorithms in tree and graph; implementations of tree and graph with array, linked-list and STL for problem-solving; 4. Sorting algorithms (selection, insertion, bubble, quick, merge) and searching algorithms (binary, hashing) for storing, arranging and ordering data; analysis of algorithms; 5. Hash table data structure	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	

Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++ 4ed”, Addison-Wesley, New Jersey, 2014 Robert Sedgewick, Philippe Flajolet, “An Introduction to the Analysis of Algorithms 2ed”, Addison-Wesley, New Jersey, 2013

Module name	**Object Oriented Programming**
Module level	Undergraduate
Code	IF184301
Courses (if applicable)	**Object Oriented Programming**
Semester	3
Lecturer	Rizky Januar Akbar, S.Kom.,M.Eng. (PIC) Fajar Baskoro, S.Kom., M.T. Ridho Rahman Hariadi S.Kom, M.Sc.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, project
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Data Structure
Course description	In this course students will learn how to model programming problem using object-oriented concepts. The object-oriented programming concepts are class concept, inheritance, overriding, overloading, polymorphism, abstract class interface, and object life cycle in computer memory. In this course students will be introduced with standard library in object-oriented language (collections, iterator, GUI) and encouraged to build a reliable program.

Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to explain object-oriented programming concept and object-oriented programming language features.	PLO7, PLO9
	CO2 Students are able to analyze problems using object-oriented approach.	PLO7, PLO9
	CO3 Students are able to model solutions to problems using an object-oriented language.	PLO7, PLO9
	CO4 Students are able to implement programming solutions to a problem using an object-oriented language.	PLO7, PLO9
Content	1. Procedural concept and the problems. 2. Class concept (fields, methods, constructors), and object (state and behavior). 3. Class diagram modelling. 4. Inheritance, overriding, sub class. 5. Dynamic dispatch: definition of method-call. 6. Polymorphism, upcasting and downcasting. 7. Abstract class, interface 8. Object lifetime: constructor, destructor, finalizer, memory management (heap and stack, garbage collection). 9. Standard library in object-oriented programming language: collection, iterator, multithreading, GUI (Graphichal User Interface). 10. Exception handling	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	

Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Deitel, P., &Deitel, H. (2011). C++ How to Program (8th Edition). Prentice Hall. Lippman, S. B., Lajoie, J., & Moo, B. E. (2012). C++ Primer (5th Edition). Addison-Wesley Professional. McConnell, S. (2004). Code Complete: A Practical Handbook of Software Construction, Second Edition (2nd edition). Microsoft Press. Gamma, E., Helm, R., Johnson, R., &Vlissides, J. (1994). Design Patterns: Elements of Reusable Object-Oriented Software (1st edition). Addison-Wesley Professional.

Module name	**Linear Algebra**
Module level	Undergraduate
Code	IF184302
Courses (if applicable)	**Linear Algebra**
Semester	3
Lecturer	Dr. Bilqis Amaliah, S.Kom, M.Kom (PIC) Dr. Yudhi Purwananto, S.Kom, M.Kom
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	2. Undergraduate degree program: lectures, < 60 students, 3. International undergraduate program: lectures, < 40 students
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulation	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Calculus 2
Course description	In this course, students learn how to solve the system linear equations (SLE) problem using computational matrix. SLE can be done using Gaussian elimination, Gauss-Jordan elimination and Cramer's rules. In order to better understand the material for the students, it needs to be implemented into a particular programming language. Matrix operation problem begins with determinant and continues with inverse matrix. The determinant can be done using Elementary Row Operations (ERO) and cofactor. Invers matrix can be done using ERO, cofactors and Pseudo-inverse. Implementation to the program are also required to make students more proficient. In vector space, students learn field equations, parametric equations, symmetric equations, dot product, cross product, and linear transformations. Basis include spans, linear independent, homogeneous linear equations, old basis and new basis, the general solution, basis row

	space, basis column space, orthonormal bases, gram schmidt. Next is about eigenvalues, student learn about eigenvalue and eigenvector, diagonalization, orthogonal diagonalization (practice using the program). In order to further explore the material, case examples of linear algebra will give.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	PLO5, PLO6
	CO1 Students are able to understand and solve linear equation system problems using matrix computing.	PLO5, PLO6
	CO2 Students are able to solve matrix operation problems.	PLO5, PLO6
	CO3 Students are able to solve vector space problems	PLO5, PLO6
	CO4 Students are able to find bases.	PLO5, PLO6
	CO5 Students are able to solve eigen problems.	PLO5, PLO6
Content	2. System Linear Equations; Gaussian elimination, Gauss-Jordan elimination and Cramer's rules (using program). 3. Matrix and operation, determinant, determinant using Elementary Row Operations (ERO) and cofactor. 4. Invers matrix using ERO, cofactors and pseudo-inverse. 5. Vector space, field equations, parametric equations, symmetric equations, dot product, cross product, and linear transformations. 6. Basis, spans, linear independent, homogeneous linear equations, old basis and new basis, the general solution, basis row space, basis column space, orthonormal bases, gram Schmidt. 7. Eigenvalue dan eigen vector, diagonalization, orthogonal diagonalization (using program). 8. Case example in linear algebra.	
Study and examination requirements and forms of examination	The final grade in the module is composed of: 1. Two short computer-based quizzes: 15% x 2 = 30% 2. Take-home written assignments: 15% 3. Written midterm assessment: 25% 4. Final oral exam: 30%	

	Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Elementary Linear Algebra; Howard Anton, Drexel University, John Wiley & Sons, Inc; Ninth Edition, 2005. Elementary Linear Algebra - Applications Version; Howard Anton, Chris Rorres; John Wiley & Sons, Inc; Ninth Edition, 2005.

Module name	**Numerical Computation**	
Module level	Undergraduate	
Code	IF184303	
Courses (if applicable)	**Numerical Computation**	
Semester	3	
Lecturer	Victor Hariadi, S.Si, M.Kom (PIC) Dr. Ahmad Saikhu, S,Si, MT.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Math 2	
Course description	The course of numerical computation will give the comprehensive knowledge dan skill of computation for many numerical problems. Students will give many exercises which can improve their analysis skill to solve any numerical problem, including to find fine approximation value for appropriate problems using several methods.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the meaning of significant numbers and rounding and Taylor series	PLO5, PLO9
	CO2 Students are able to apply methods to get the roots of equations	PLO5, PLO6, PLO9

	CO3 Students are able to apply methods for curve matching with regression and interpolation techniques	PLO5, PLO6, PLO9
	CO4 Students are able to apply methods to differentiate through a numerical approach	PLO5, PLO6, PLO9
	CO5 Students are able to apply methods to perform integration through a numerical approach and to differentiate functions with a single independent variable (ordinary differentiation) or with 2 or more independent variables (partial differentiation).	PLO5, PLO6, PLO9
Content	• Introduction to Numerical Computation - Significant Figures - Errors Definition - Round-off Errors - Taylor Series • Root of Equation: Bracketing (Accolade) Methods - Graphical Method - Table Method - Bolzano Method - False Position Method - Factorization Method - Quotient-Difference Method • Root of Equation: Open Methods - Iteration Method - Newton-Raphson Method - Secant Method - Brent's Method - Multiple Roots • Roots of Polynomial - Polynomials in Engineering and Science - Muller's Method - Bairstow's Method • Curve Fitting: Least-Squares Regression - Linear Regression - Polynomial Regression • Curve Fitting: Interpolation - Finite-Difference - Newton-Gregory Interpolation - Gauss Interpolation	

	- Lagrange Interpolation - Hermite Interpolation • Numerical Integration - Trapezoidal Method - Simpson Method - Quadrature Method - Rhomberg Method • Ordinary Differential Equation (ODE) - Euler-Cauchy Method - Heun Method - Picard Method - Taylor Method - Runge-Kutta Method - Adam Method - Milne Method - Adam-Moulton Method • Partially Differential Equation (PDE) - Elliptical PDE - Parabolic PDE - Hyperbolic PDE
Study and examination requirements and forms of examination	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Chapra, S.C., Canale, R.P.," Numerical Methods for Engineers 6th Ed", McGraw-Hill, 2010 Hariadi, V.," Bahan Ajar Komputasi Numerik", 2014

Module name	**Discrete Mathematics**	
Module level	Undergraduate	
Code	IF184304	
Courses (if applicable)	**Discrete Mathematics**	
Semester	3	
Lecturer	Dr. Yudhi Purwananto, S.Kom., M.Kom. (PIC) Victor Hariadi, S.Si, M.Kom. Arya Yudhi Wijaya, S.Kom.,M.Kom. Dr. Ahmad Saikhu, S,Si, MT.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Course description	In this course, students will learn the concept of logic, methods of proof, which include a set of discrete structures, functions and relations, the concept of counting, and recursive. The purpose of this course is the student able to explain the concepts of logic, methods of proof, sets, functions, mathematical induction and recursion, relationship and apply them to real problems, both with the performance of individuals and in groups in teamwork. This course is a prerequisite for the course Linear Algebra, Design and Analysis of Algorithm I, Graph Theory, Statistics, and Automata.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 The students can understand the concepts and equivalence proposition logic, predicates and	PLO5, PLO9

	quantifiers concept, the use of quantifiers in the proposition, and the concept of the rule of determining conclusions.	
	CO2 Students are able to understand the concept of proof methods such as direct evidence, proof by contraposition, proof by contradiction	PLO5
	CO3 Students are able to understand the definition of the set, the operation on the set, the concept of function, the concept of a relation, equivalence relation, partial ordering	PLO5
	CO4 Students are able to understand the concept of mathematical induction, the concept of strong induction, the method of proof by strong induction and well ordering, recursive definitions, structural induction	PLO5
	CO5 Students are able to understand the basic counting, Pigeonhole principle, permutations and combinations, binomial coefficients and Identity, recurrent relations and their applications, solutions recurrent relations, and to apply Discrete Mathematics in some cases	PLO5, PLO9
Content	• BASIC CONCEPTS OF LOGIC: Concepts and equivalence proposition logic, predicates and quantifiers concept, the use of quantifiers in the proposition, and the concept of the rule of determining conclusions. • Methods Basic Concepts of Evidence: The concept of proof methods such as direct evidence, proof by contraposition, proof by contradiction. • Basic Concepts Discrete Structures: Definition of the set, the operation on the set, the concept of function, the concept of a relation, equivalence relation, partial ordering. • Method of Evidence with Induction and Recursion: The concept of mathematical induction, the concept of strong induction, the method of proof by strong induction and well ordering, recursive definitions, structural induction.	

	• Basic Concept of Calculation: Basic counting, pigeonhole principle, permutations and combinations, binomial coefficients and Identity, recurrent relations and its applications, solutions recurrent relations.
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Kenneth H. Rosen, "Discrete Mathematics and its Applications 7th edition", McGraw-Hill Incorporated, New York, 2012. Andrew Simpson, "Discrete Mathematics by Example", McGraw-Hill Incorporated, New York, 2002. Norman L. Biggs, "Discrete Mathematics", Oxford University Press, 2002.

Module name	**Computer Organization**	
Module level	Undergraduate	
Code	IF184305	
Courses (if applicable)	**Computer Organization**	
Semester	3	
Lecturer	Dr. Wahyu Suadi, S.Kom., MM., M.Kom. (PIC) Prof. Ir. Supeno Djanali, MSc, Ph.D. Ir. Muchammad Husni, M.Kom Prof. Tohari Ahmad, S.Kom, M.IT, Ph.D Henning Titi Ciptaningtyas, S.Kom, M.Kom	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	Undergraduate degree program: lectures, < 60 students, International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture	
Workload	Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Digital System	
Course description	This course explains the basic operation of computer and its components and the sequence of execution of the instruction. It also explains the organization and function of each component as well as the concept of pipelining as one type of paralllel processing.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	PLO2, PLO9
	CO1 Accuracy in explaining the basis of computer work and its leverage component.	PLO2, PLO9
	CO2 Accuracy in explaining the concept of assembly language and subroutine	PLO2, PLO9

	CO3 Accuracy in explaining the basic concepts of the processing unit and complete instruction execution	PLO2, PLO9
	CO4 Accuracy in explaining the arithmetic process both in terms of its algorithm and its hardware	PLO2, PLO9
Content	Basic Computer Structure: computer architecture and organization, computer structure and and its internal functions, evolution and computer generations. Machine Instructions and Program: Memory address and location, basic memory operation, instruction and its sequence of execution, addressing modes, assembly language, stack & queue, subroutines, examples of some instruction sets. Input/Output Organization: Input/Output organization, I/O access, interrupt, Direct Memory Access, standard I/O interface. Memory System: Basic concept of memory system, Random Access Memory (RAM), Read Only Memory (ROM), Cache Memory: Mapping, Replacement Algorithm, Virtual Memory, Secondary Storage. Arithmetics: add and subtract, Fast Adder, multiplication of positive numbers, multiplication of sign numbers, Booth algorithm, Fast Multiplication, division of integer numbers, real number and its operation. Processing Unit: Basic concept of processing unit, execution of the whole instruction, multiple bus organization, Hardwired Control, Multiprogrammed Control. Pipelining: Basic concept of pipelining, data & instruction hazard, Superscalar operation.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final written exam (60 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final written exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	Supeno Djanali & Baskoro Adi P., Organisasi Komputer, ITS Press, 2012 Hamacher, Vranezic & Zaky, Computer Organization and Embedded Systems (6th Edition), McGraw-Hill, 2011. William Stallings, Computer Organization and Architecture (9th Edition), Prentice-Hall, 2012. Morris Mano, Computer System Architecture (3rd Edition), Prentice-Hall, 1993.

Module name	**Database System**
Module level	Undergraduate
Code	IW184301
Courses (if applicable)	**Database System**
Semester	3
Lecturer	Dwi Sunaryono, S.Kom., M.Kom. (PIC) Adhatus Solichah Ahmadiyah, S.Kom., M.Sc.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	Lecture, lab works, project
Workload	1. Lectures: 4 x 50 = 200 minutes (3 hours 20 minutes) per week. 2. Exercises and Assignments: 4 x 60 = 240 minutes (4 hours) per week. 3. Private study: 4 x 60 = 240 minutes (4 hours) per week.
Credit points	4 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Data Structure
Course description	Through this course, students will learn about how to model data and information in the form of charts and diagrams concept of physical and apply it to the database in a DBMS using DDL. Students also learn about the concept of relational algebra and data manipulation language (DML) and its application to manage data and information in a database. Students also learn to create database applications to manipulate data in the database. Concepts and practice are done in the classroom and laboratory individual and group. Case studies are used in lectures is a real.

Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Understand the stages of the database system development life cycle, the main phases of database design which include conceptual design, logical design, and physical design	PLO6, PLO9
	CO2 Understand the basic concepts associated with the Entity-Relationship (ER) Model (entities, relationships, and attributes) and Enhanced-ER (EER) Model (class/subclass relationships, specialization and generalization, and categories), and be able to perform basic conceptual designs relational data using ER and EER Models	PLO6, PLO9
	CO3 Able to design logical databases for relational data models using the conversion algorithm of conceptual database design results (ER/EER schemes) into a set of relations, and be able to refine logical database designs for relational data models using functional dependency and data normalization	PLO6, PLO9
	CO4 Able to specify data retrieval requests using relational algebra, able to create database schemas and tables using SQL commands, and able to define queries, constraints, and updating data in SQL	PLO6, PLO9
	CO5 Able to map logical database designs into physical database designs using a specific database management system (DBMS) as a target, and understand physical database design methodologies and be able to apply them to improve database performance through tuning, indexing data, improving database design, and query refinement	PLO6, PLO9
Content	1. BASIC CONCEPTS OF INFORMATION MANAGEMENT: differences in the data, information and knowledge; benefit from data and information to support human needs; demonstration of the use of data and information for the organization; identification of issues persistent data usage in organizations; evaluation of the use of small to medium scale applications to meet the real needs of users. 2. DATABASE SYSTEMS: characteristics that distinguish the database approach with traditional approaches to programming with data files; evolution of database and systems approach; the basic purpose, function model, application components and social impact from database systems ; identification of the main	

	function from DBMS and describing its role in the system database; concept of data independence and importance in the database systems; the use of declarative query language to obtain information from databases; 3. DATA MODELLING: categories based on the type of concept data model is provided to describe the structure of the database (concept data model, physical data model, and representational data model), modelling concepts and the use of modelling notation (ERD, UML); relational data model, the basic principles of the relational data model, modelling concepts and notation of the relational data model; The main concept of OO model such as identity, type constructor, inheritance, polymorphism, and versioning; differences in relational data model with semi-structured data model (DTD, XML Schema). 4. RELASIONAL DATABASE: relational schema from conceptual model created using the model er; relational database design; the concept of integrity constraints and referential integrity constraints; the use of relational algebra operations from mathematical set theory (union, intersection, difference, and Cartesian product) and relational algebra operations to database (select, restrict, project, join, and division); query in the tuple relational algebra and relational calculus; Functional dependence between two or more attributes that are a subset relations, Decomposition of a schema; lossless-join and dependency-preservation properties of a decomposition, Candidate keys, superkeys, and closure of a set of attributes, Normal forms (1NF, 2NF, 3NF, BCNF), Multi-valued dependency (4NF), Join dependency (PJNF, 5NF), Representation theory. 5. QUERY LANGUANGE: database language, SQL (DDL and DML for define data structure, query, update, boundaries, and integrity); QBE and 4^{th}-gen environments, Explicite Set & NULL, Rename, Aggregate Function & Grouping, Arithmetic Operator & Ordering, VIEW in SQL. 6. DATABASE APPLICATION
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15%

requirements and forms of examination	• Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	1. Ramakrishnan, Raghu, Gehrke, Johannes. 2003. Database Management Systems, Third Edition. New York: The McGraw-Hill Companies, Inc. 2. Howe, David; Data analysis for Database Design, third Edition, Butterworth-Heineman, 2001

Module name	**Design and Analysis Algorithms**	
Module level	Undergraduate	
Code	IF184401	
Courses (if applicable)	Design and Analysis Algorithms	
Semester	4	
Lecturer	Rully Sulaiman, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, lab works, project	
Workload	1. Lectures: 4 x 50 = 200 minutes (3 hours 20 minutes) per week. 2. Exercises and Assignments: 4 x 60 = 240 minutes (4 hours) per week. 3. Private study: 4 x 60 = 240 minutes (4 hours) per week.	
Credit points	4 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Data Structure	
Course description	In this course, students will learn about design and algorithm analysis in programming. The concepts that will be discussed including algorithm complexity calculation in asymptotic notation, analyze the correctness of the algorithm using loop invariant from iterative and divide-conquer algorithms. Students are also expected able to explain the strategy and design of algorithms and implement them to solve programming problems.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Course participants can model computational problems algorithmically.	PLO1, PLO5, PLO7

	CO2 Course participants can apply the optimal algorithm design to a particular computational problem model	PLO1, PLO5
	CO3 Course participants are able to analyze algorithm designs which include aspects of correctness and complexity.	PLO1, PLO7
	CO4 Course participants are able to implement algorithm designs involving efficient data structures using object-oriented programming language	PLO1, PLO8, PLO9
Content	1. Algorithm definition, problem solving fundamental algorithmically, main problem definition, data structure reviews 2. Asymptotic notation, basic notation, general functions. 3. Recursive and non-recursive algorithms analysis (master theorem)	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Levitin, Anany, “Introduction to The Design & Analysis Af algorithms 3rd ed”, Addison-Wesley, 2012 • Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms Third Edition”, MIT Press, 2009	

Module name	**Operating System**	
Module level	Undergraduate	
Code	IF184402	
Courses (if applicable)	**Operating System**	
Semester	4	
Lecturer	Dr. Wahyu Suadi, S.Kom., MM., M.Kom. (PIC) Ir. Muchammad Husni, M.Kom Bagus Jati Santoso, S.Kom., Ph.D. Henning Titi Ciptaningtyas, S.Kom, M.Kom Dr. Eng. Royyana Muslim I, S.Kom, M.Kom	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, lab works, project	
Workload	1. Lectures: 4 sks x 50 = 200 minutes (3 hours 20 minutes) per week. 2. Exercises and Assignments: 4 x 60 = 240 minutes (4 hours) per week. 3. Private study: 4 x 60 = 240 minutes (4 hours) per week.	
Credit points	4 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Organization	
Course description	In computing and its applications, Operating systems have important role in managing basic computing resources such as I/O and its peripheral, memory and processor. This course discusses the design and principles of the operating systems managing the computing resource in a computer.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand and apply the basic concepts of operating systems and process life cycles and apply communication between processes	PLO2, PLO9

	CO2 Students are able to understand and apply multiprocess and multithreaded synchronization mechanisms	PLO2, PLO9
	CO3 Students are able to understand and apply the concept of memory management, several page replacement algorithms, paging/segmentation mechanisms and apply several process scheduling algorithms	PLO2, PLO9
	CO4 Students are able to understand the connection between I/O hardware and I/O software and implement file systems	PLO2, PLO9
Content	The basic concept of operating systems, process life cycle, interprocess communication. Multiprocess synchronization mechanism and the multithread Memory management, page replacement, paging and segmentation algorithm. Process scheduling and its algorithm Relationship and connectivity between I/O hardwares and I/O softwares. Potential attack types in the operating systems as well as its security measures.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	Requirements for successfully passing the module: *the final grade in the module is composed of 60% performance on exams, 10% quizzes, 10% take-home assignments, 10% in-class participation. Students must have a final grade of 60% or higher to pass*	
Reading List	William Stallings, Operating Systems: Internals and Design Principles, Prenctice Hall.	

Module name	**Artificial Intelligence**
Module level	Undergraduate
Code	IF184403
Courses (if applicable)	**Artificial Intelligence**
Semester	4
Lecturer	Shintami Chusnul Hidayati, S.Kom., M.Sc., Ph.D. (PIC) Prof.Ir.Handayani Tjandrasa, M.Sc, Ph.D. Dr. Eng. Nanik Suciati, S.Kom, M.Kom Dr. Eng. Chastine Fatichah, S.Kom, M.Kom Dini Adni Navastara, S.Kom., M.Sc.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Data Structure
Course description	In this course, students will learn about intelligent agent both theoretical in class and practical through project task. Intelligent agent will use searching algorithms, knowledge-based algorithms and learning-based algorithms. Searching algorithms include uninformed/informed search algorithm, heuristic search, adversarial search and searching algorithm for constraint satisfaction problem. Knowledge-based algorithms include representation and inference propositional logic, first order logic, reasoning under uncertainty. Learning based algorithms will be discussed about statistical learning algorithm. Beside theory, in this course will be delivered some case studies through project tasks related to intelligent agent by using searching algorithm, knowledge-based algorithms or statistical

	learning algorithm. Project tasks can be done individually and team work. Therefore, students have learning experience and able to think critically about the intelligent agent applications.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand and explain the concept of artificial intelligence, intelligent agents, and identify problems that can be solved by utilizing intelligent agents.	PLO1, PLO9
	CO2 Students are able to explain, identify, design, and apply intelligent agents for appropriate problems by utilizing search algorithms, which include uninformed search, informed search, heuristic search, adversarial search, and search algorithms for Constraint Satisfaction Problems.	PLO1, PLO7, PLO9
	CO3 Students are able to explain, design, and apply knowledge-based intelligent agents by representing the knowledge base into propositional logic or first order logic and utilizing resolution, forward, and backward chaining algorithms to perform the inference process.	PLO1, PLO7, PLO9
	CO4 Students are able to explain, design, and apply intelligent agents to uncertainty problems using Bayesian networks and probabilistic reasoning.	PLO1, PLO7, PLO9
	CO5 Students are able to explain, design, and apply intelligent agents that utilize statistical learning algorithms.	PLO1, PLO7, PLO9

Content	- Concepts of Artificial Intelligence
	- Intelligent Agent,
	- Searching Algorithms:
	  - Uninformed Search,
	  - Informed Search,
	  - Heuristic Search,
	  - Adversarial Search, and
	  - Searching algorithm for Constraint Satisfaction Problem.
	- Representation and Inference
	  - Resolution,
	  - Forward-chaining, and
	  - Backward Chaining.
	- Propositional Logic and First Order Logic	

	- Reasoning Under Uncertainty and Statistical Learning
	  - Bayesian Learning,
	  - Maximum A Posteriori Approximation (MAP),
	  - Maximum Likelihood Approximation,
	  - Parameter Learning,
	  - Naïve Bayes Model,
	  - Parameter Learning,
	  - EM Algorithm,
	  - Log-likelihood Function,
	  - Hidden Markov Model,
	  - Maximization,
	  - Miss Data,
	  - E-step,
	  - M-step, And
	  - Mixed Attributes Example.

Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Russel & Norvig, Artificial Intelligence: A Modern Approach R.O. Duda, P.E.Hart, D.G.Stork, Pattern Classification, John Wiley & Sons, Inc., 2001 Amit Konar, Computational Intelligence, Springer, 2005. C. H. Bishop, Pattern Recognition and Machine Learning, Springer Science, 2006

Module name	**Database Management**
Module level	Undergraduate
Code	IF184404
Courses (if applicable)	**Database Management**
Semester	4
Lecturer	Adhatus Solichah Ahmadiyah, S.Kom., M.Sc. (PIC) Kelly Rossa Sungkono, S.Kom., M.Kom Dwi Sunaryono, S,Kom., M.Kom Sarwosri, S.Kom. M.T Nurul Fajrin Ariyani, S.Kom., M.Sc.
Language	Bahasa Indonesia dan English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	Lecture, lab works, project
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Database System
Course description	Students will learn about modeling of complex systems in industry based on business process. According to the reference model, students will implement and manage an optimal SQL database. Lectures are presented in classroom and students will work on small project as a practice. The aim of this course is to provide experience to students about managing and handling problems when working in large-scale data. This course will cover distributed database and data warehouse as well.
	After completing this module, a student is expected to:

<table>
<tr><td rowspan="3">Learning outcomes and their corresponding PLOs</td><td>CO1 Students can model database from various industrial fields.</td><td>PLO1, PLO6</td></tr>
<tr><td>CO2 Students can handle the problem in a large-scale database.</td><td>PLO6</td></tr>
<tr><td>CO3 Students can model an active database integrated with business rules.</td><td>PLO6</td></tr>
<tr><td>Content</td><td colspan="2">System Analyst and Development of Information Systems: System Analyst (Competency and role). Development of information systems, Software development life cycle (Planning, Analysis, Design and Implementation). Identification and initialization of Information Systems Project, Feasibility Analysis Project (Technique, Economy and organization).
Analysis Phase: Requirement establish (understand business process, issues domain, organizations, and stakeholder). Technique to get requirement (Interview, questioners, Observation, document analysis, selecting appropriate technique). Strategic to do analysis requirement (Problem analysis, root course analysis, activity-based costing).
Requirement Modelling: Process modeling (Data Flow Diagram, Data Dictionary, Functional Decomposition Diagrams). Data Modelling (Entity Relationship Diagram/ Conceptual Data Model). Object Model (Use Case Diagram, Activity Diagram, Sequence Diagram, Class Analysis, Class Diagram analysis level).
Development Strategic: Internet Impact (Software as a Services (SaaS), Web Based System Development, Cloud Computing), Outsourcing, In House Software Development option, Role analyst systems, Analysis of cost and benefit, Process of software acquisition, Transition system to design, design system guide, Prototyping, Software development trend.
Design Phase: Translation from Analysis to Design, Architectural Design (Element - element, Client Server, User Interface and report Design, Code Design and data storage design.</td></tr>
<tr><td>Media employed</td><td colspan="2">LCD, whiteboard, websites, books (as references), online meeting, etc.</td></tr>
</table>

Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	. Avi Silberschatz, “Database System Concepts”, 5th edition, 2002. . Morgan Kaufman, “Advanced Database System”, Morgan Kaufman Publisher Inc., 1993. . Howe, David, “Data Analysis for Database Design”, 3th edition. Butterworth-Heineman, 2001. . Ramakrishnan, Raghu, Gehrke, Johannes. “Database Management Systems”, 3th ed., New York: The McGraw-Hill Companies Inc., 2003.

Module name	**Probability and Statistics**	
Module level	Undergraduate	
Code	IF184405	
Courses (if applicable)	**Probability and Statistics**	
Semester	4	
Lecturer	Dr. Ahmad Saikhu, S,Si, MT. (PIC) Victor Hariadi, S.Si, M.Kom	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; mandatory; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Discrete Mathematics	
Course description	In this course, students will learn about Sample Space, Event Space, Probability Axioma, and Probability Formula, Conditional Probability, Bayesian Theory, Random Variable, Discrete and Continue Probability, Expectation, Sampling Distribution, Estimation, Hypothesis Testing, Analysis of Variance and Principle Component Analysis.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students can make probability models from a random experiment with the Bayes theory and the probability density function of random variables.	PLO5
	CO2 Students can explain the concepts of expectations, variance, covariance and can calculate the correlation value.	PLO5

	CO3 Students can calculate estimators of population parameters and draw conclusions.	PLO7
	CO4 Students can test hypotheses from population parameters and draw conclusions.	PLO7
Content	• Sample Space • Event Space • Probability Axioma and Probability Formula • Conditional Probability • Bayesian Theory • Random Variable • Discrete and Continue Probability • Expectation • Sampling Distribution • Estimation • Hypothesis Testing • Analysis of Variance • Principal Component Analysis	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	

Reading List	Ronald E. Walpole, Raymond H. Myers, “Probability & Statistics for Engineers & Scientists”, 9th Edition, Prentice-Hall Inc., 2010. Michael Baron, “Probability & Statistics for Computer Scientists”, Chapman & Hall, 2007. Sheldon Ross, “A First Course in Probability”, Prentice Hall, 9th Edition, 2012.

Module name	**Analysis and Design of Information Systems**	
Module level	Undergraduate	
Code	IF184406	
Courses (if applicable)	**Analysis and Design of Information Systems**	
Semester	4	
Lecturer	Sarwosri, S.Kom., M.T. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Data Structure	
Course description	In this course, students will analyze systems according to requirements definition, techniques to obtain requirements and requirements analysis strategy. Students will model the requirements using the notations that are generated using methods and tools such as Data Flow Diagram (DFD), Data Dictionary, Unified Modelling Language (Object), Functional Decomposition Diagram (FDD), Entity Relationship Diagram (ERD). Students will transform the analysis result into design of software architecture, user interface, source code and data storage.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students understand the role of Systems Analyst and understand information system development	PLO8

	CO2 Students are able to understand business processes and determine user requirements.	PLO3, PLO8
	CO3 Students are able to model requirements by modeling processes, data and objects.	PLO3, PLO9
	CO4 Students are able to translate the results of analytical modeling into designs which include architectural design, user interfaces and reports, programs and data storage.	PLO3, PLO9
Content	1. System Analyst and Development of Information Systems: System Analyst (Competency and role). Development of information systems, Software development life cycle (Planning, Analysis, Design and Implementation). Identification and initialization of Information Systems Project, Feasibility Analysis Project (Technique, Economy and organization). 2. Analysis Phase: Requirement establish (understand business process, issues domain, organizations, and stakeholder). Technique to get requirement (Interview, questioners, Observation, document analysis, selecting appropriate technique). Strategic to do analysis requirement (Problem analysis, root course analysis, activity based costing). 3. Requirement Modeling: Process modeling (Data Flow Diagram, Data Dictionary, Functional Decomposition Diagrams). Data Modeling (Entity Relationship Diagram/ Conceptual Data Model). Object Model (Use Case Diagram, Activity Diagram, Sequence Diagram, Class Analysis, Class Diagram analysis level). 4. Development Strategic: Internet Impact (Software as a Services (SaaS), Web Based System Development, Cloud Computing), Outsourcing, In House Software Development option, Role analyst systems, Analysis of cost and benefit, Process of software acquisition, Transition system to design, design system guide, Prototyping, Software development trend. 5. Design Phase: Translation from Analysis to Design, Architectural Design (Element - element, Client Server, User Interface and report Design, Code Design and data storage design.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15%	

	• Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Dennis Wixom Roth, System Analysis & Design, 5 th, Wiley, 2009 Shelly Rosenblatt, Systems Analysis and Design, 8 th, Course Technology, 2010 Ian. Sommerville, Software Engineering, 9th ed., Addison-Wesley, 2011. M. Page-Jones, Fundamentals of Object-Oriented Design in UML, 1st ed., Addison-Wesley, 1999

Module name	**Software Design**
Module level	Undergraduate
Code	IF184501
Courses (if applicable)	**Software Design**
Semester	5
Lecturer	Nurul Fajrin Ariyani, S.Kom., M.Sc. (PIC)
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, project
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Object Oriented Programming, Web Programming (taking)
Course description	Through this course, students will be able to understand software design principles, decompose complexity of the problem domain, able to select suitable software design approach for a given problem domain, able to select an architecture which is suitable with software to be constructed, able to utilize design patterns on design problems. At the end, students have the ability to create software design model which is able to anticipate changes on the given case study using certain approach.

Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to explain the software design principles.	PLO3
	CO2 Students can explain and choose approaches to software design according to the problem domain.	PLO3
	CO3 Students can identify the types of software architecture and the differences between software architectures.	PLO3
	CO4 Students can describe the details of the system at the lower level by using design patterns that are appropriate to the problem.	PLO3, PLO7
	CO5 Students can develop interface designs and apply software design to simple case studies.	PLO3, PLO7
Content	Software design principles: abstraction; coupling and cohesion; decomposition and modularization; encapsulation; separating of interface and implementation; sufficiency, completeness, and primitiveness; and separation of concerns. Key issues in software design: concurrency; event handling; data persistence; error handling; fault tolerance; security; etc. Types of Software. Software design approach: top-down; bottom-up; function-oriented; data structure-centered; object-oriented; and component-based. Software Architecture Concepts: client-server; three-tier; Model-View-Controller; etc. Design patterns: several patterns which is suitable with problem domain such as creational patterns; structural patterns; and behavioural patterns. Framework reuse. Interface Design.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	D. Budgen, Software Design, 2nd ed., Addison-Wesley, 2003. Robert C. Martin and Micah Martin, Agile Principles, Patterns, and Practices in C#, Prentice Hall, 2006. Sommerville, Software Engineering, 9th ed., Addison-Wesley, 2011. E. Gamma et al., Design Patterns: Elements of Reusable Object-OrientedSoftware, 1st ed., Addison-Wesley Professional, 1994. P. Bourque and R.E. Fairley, eds., Guide to the Software Engineering Body of Knowledge, Version 3.0, IEEE Computer Society, 2014.

Module name	**Computer Graphics**	
Module level	Undergraduate	
Code	IF184502	
Courses (if applicable)	**Computer Graphics**	
Semester	5	
Lecturer	Siska Arifiani, S.Kom., M.Kom. (PIC) Hadziq Fabroyir, S.Kom., Ph.D. Anny Yuniarti, S.Kom, M.Comp.Sc Wijayanti Nurul Khotimah, S.Kom, M.Sc	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Object Oriented Programming	
Course description	In this course, students are taught a variety of materials and practices in order to be able to create an interactive graphics application program for designing specific objects according to user needs in real world by using graphics library (e.g., OpenGL and Direct3D).	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Explain and demonstrate the basics of graphics system and pipeline in the graphics libraries based on examples	PLO4, PLO8, PLO9

	CO2 Explain the concepts of geometry, representation, and object transformation	PLO4, PLO8, PLO9
	CO3 Create interactive graphics programs that involves the concept of object transformation	PLO4, PLO7, PLO8, PLO9
	CO4 Apply the concept of 3D viewing and rendering to graphics programs	PLO4, PLO7, PLO8, PLO9
	CO5 Work in a team exploring modern graphics libraries	PLO4, PLO7, PLO8, PLO9
Content	1. Fundamentals of graphics systems and graphics programming using graphics library (OpenGL and Direct3D), World window dan viewport, Vector tool, Transformation, Polygonal Mesh, Hierarchy Modelling, Viewing, Rendering, Raster display, Curve and surface.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	1. Problem 1 in mid-term exam (5%) and exercise 1 (5%) - 10% 2. Problem 2 in mid-term exam (5%) and exercise 2 (5%) - 10% 3. Problem 3 in mid-term exam (5%); problem 4 in mid-term exam (5%); assignment 1: make an algorithm and computer program (5%); and exercise 3 (5%) - 20% 4. Problem 5 in mid-term exam (5%); problem 1 in final exam (5%) and exercise 4 (5%) - 15% 5. Problem 2 in final exam (5%); assignment 2: make a function and recursive (5%); and exercise 5 (5%) - 15% Problem 3 in final exam (5%) and exercise 6 (5%) - 10% 6. Problem 4 in final exam (5%) and exercise 7 (5%) - 10% 7. Problem 5 in final exam (5%) and assignment 3: make a program based on a real-life problem (5%) - 10%	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25%	

	• Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	. FS Hill Jr, “Computer Graphics using OpenGL”. . Edward Angel, “Interactive Computer Graphics: A Top-Down Approach Using OpenGL”, Sixth Edition, Pearson International Inc, 2012. . Edward Angel, “OpenGLTM: A Primer”, Third Edition, AddisonWesley, 2002. . Frank Luna, “Introduction to 3D Game Programming with DirectX 11”, Mercury Learning & Information, 2012. . Jason Zink, “Practical Rendering and Computation with Direct3D”, A K Peters, 2011. . Donald Hearn and M. Pauline Baker, “Computer Graphics with OpenGL”, 3rd Edition. . Alan Watt, “3D Computer Graphics”, Addison-Wesley.

Module name	**Computational Intelligence**
Module level	Undergraduate
Code	IF184503
Courses (if applicable)	**Computational Intelligence**
Semester	5
Lecturer	Dr. Eng. Chastine Fatichah, S.Kom, M.Kom (PIC) Prof.Ir. Handayani Tjandrasa, M.Sc, Ph.D. Dr. Eng. Nanik Suciati, S.Kom, M.Kom Dini Adni Navastara, S.Kom., M.Sc.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Artificial Intelligence
Course description	In this course students learn about the methods of classification, clustering methods, optimization methods, fuzzy logic, and a combination of these methods. Through theoretical discussion in the classroom as well as the application of case studies in the form of project assignments, students will have the experience to make an intelligent system with supervised learning based classification methods (Decision Tree, SVM, Neural Networks), to build intelligent systems based on unsupervised learning methods such as clustering methods (K-Means, Hierarchical Clustering, SOM), to create intelligent systems using fuzzy logic, to make intelligent systems based on optimization methods (GA, PSO, ACO), and to create intelligent systems that combine these methods. The task of the projects can be done individually or in groups.

Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to explain and apply the clustering method and its use in an application	PLO1
	CO2 Students are able to explain and apply the concepts of Decision Tree and Fuzzy Logic and their use in rule-based systems	PLO1
	CO3 Students are able to explain and apply the concept of classifier with linear and non-linear discriminant functions	PLO1
	CO4 Students are able to explain the concept of Reinforcement Learning and its use in an application	PLO1
	CO5 Students are able to explain, design, and apply optimization methods and their use in classification and clustering problems	PLO1, PLO7, PLO9

Content	• Management Concept: - Introduction to Project Management - Classical management Model • Roles in Project Management • The Structure of Organizational Management/Enterprise • Software Project Management Framework • Case Tool for Software Project Management • Project Planning • Planning and Evaluation • Work Breakdown Structure (WBS) • Task Scheduling: - Effort Estimation, - Cost Estimation, - Cost Estimation Techniques (Cocomo, Activity Base Costing, etc.), - Resources Allocation. • Risk Management: Project Proposal • Tender And Legal Aspects of The Project: - Tender, - Preparing The Legal Aspects in The Tender, - Contract Documents. • Organization and Project Personnel. • Organizational Structure, Position, Responsibilities and Authority. • Formal and Informal Communication • Project Staffing • Personnel Training, Career Development, and Evaluation • Meeting Management. • Build And Motivate Teams: - Conflict Resolution, - Project Control, - Change Control, - Reporting and Monitoring, - Analyse and Measure Project Results, - Recovery and Correction, - Reward and Discipline, - Performance Standards.

Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, 4th ed., Elsevier Inc., 2009. R.O. Duda, P.E.Hart, D.G.Stork, Pattern Classification, John Wiley & Sons, Inc., 2001 Amit Konar, Computational Intelligence, Springer, 2005. C. H. Bishop, Pattern Recognition and Machine Learning, Springer Science, 2006 Simon Haykin, Neural Networks: A Comprehensive Foundation (2nd Edition), Prentice Hall, 1998.

Module name	**Web Programming**	
Module level	Undergraduate	
Code	IF184504	
Courses (if applicable)	**Web Programming**	
Semester	5	
Lecturer	Fajar Baskoro, S.Kom., M.T. (PIC) Rizky Januar Akbar, S.Kom., M.Eng.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Teaching Methods	lecture, project	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Object Oriented Programming	
Course description	Students will learn the technologies for developing web applications to demonstrate how these technologies are employed in web sites. In addition, this course contains about the principles of website design.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to explain web programming concept.	PLO3, PLO5
	CO2 Able to analyze problems using web approach	PLO7
	CO3 Able to model problem solution using web application	PLO8, PLO9

Content	1. Web technology development and history 2. Basic HTML: tag, component and attribute 3. Implementation of client-server application using XHTML, CSS, PHP and JavaScript 4. Introduction to ASP and ASP.NET 5. Introduction of web form and class 6. Basic ADO.NET 7. Introduction to web service
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Harvey M. Deitel and Paul J. Deitel, “Internet & World Wide Web How to Program”, 4th Edition, Pearson Education, Inc. , Upper Saddle River, NJ., 2008.

Module name	**Computer Networks**	
Module level	Undergraduate	
Code	IF184505	
Courses (if applicable)	**Computer Networks**	
Semester	5	
Lecturer	Bagus Jati Santoso, S.Kom., Ph.D. (PIC) Wahyu Suadi, S.Kom, M.Kom Prof. Ir. Supeno Djanali, MSc, Ph.D. Dr. Eng. Royyana Muslim I, S.Kom, M.Kom Dr. Eng. Radityo Anggoro, S.Kom, M.Eng.Sc	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works	
Workload	Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. Private study: 3 x 60 = 180 minutes (3 hours) per week. Practical exercises 1 x 60 = 60 minutes per week (5 case studies)	
Credit points	4 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Operating System	
Course description	Students learn about the communication between computers and how the data is sent from one computer to another based on OSI Layer concept.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the concept of data transmission on computer networks and the uses of each layer in the OSI layer.	PLO2
	CO2 Students are able to apply the concept of data transmission on computer networks to existing	PLO9

	applications and design computer networks, both with individual performance and in groups in teamwork.	
Content	INTRODUCTION TO COMPUTER NETWORK: computer network usage, hardware for computer network, network software, comparison of OSI and TCP/IP model, internet history, and network standardization. APPLICATION LAYER: HTTP, Email, FTP, P2P, Server Applications TRANSPORT LAYER: Transport layer services, elements in transport layer protocol, simple transport layer protocol, UDP, TCP NETWORK LAYER: Internet Protocol version 4 (IPv4), subnetting, routing DATALINK LAYER: Ethernet, ARP, Wi-Fi, Bluetooth COMPUTER NETWORK MANAGEMENT: Basic of network management. DATA TRANSMISSION TECHNIQUES: Unicast, Broadcast, Multicast.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	
Study and examination requirements and forms of examination	Mid-term examination and Final examination. Students must have a final grade of 55.6% or higher to pass.	
Reading List	James F. Kurose and Keith W. Ross, Komputer Networking: A Top-Down Approach, 7th Edition, Addison Wesley, 2013. Andrew S. Tanenbaum and David J. Etherall, Computer Networks, 5th Edition, Prentice Hall, 2011.	

Module name	**Software Project Management**	
Module level	Undergraduate	
Code	IF184506	
Courses (if applicable)	**Software Project Management**	
Semester	5	
Lecturer	Sarwosri, S.Kom. M.T (PIC) Dr. Umi Laili Yuhana, S.Kom., M.Sc. Fajar Baskoro, S.Kom., M.T. Adhatus Solichah A., S.Kom., M.Sc.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Analysis and Design of Information Systems	
Course description	This course explains about planning of an iterative software development (activities, schedule, resource assignment, implementation methods), planning a budget and control costs and how to assess the qualifications of team members and provide appropriate assignment.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO 1 Students understand the stages of the software project life cycle	PLO3

	CO 2 Students are able to make project planning documents	PLO3
	CO 3 Stu Students are able to make a real project in a team or in groups	PLO9
	CO 4 Students are able to do monitoring and controlling between planning and actual.	PLO9
Content	1. Management Concept: Introduction to project management ,Classical Management Model 2. Roles in Project Management 3. The structure of organizational management / enterprise 4. Software project management framework 5. Case tool for software project management 6. Project Planning 7. Planning and evaluation 8. Work breakdown structure (WBS) 9. Task scheduling: Effort estimation, cost estimation, cost estimation techniques (Cocomo, activity base costing, etc.), Resources allocation 10. Risk management: Project proposal 11. Tender and legal aspects of the project: Tender, Preparing the legal aspects in the tender, Contract documents 12. Organization and Project Personnel 13. Organizational structure, position, responsibilities and authority 14. Formal and informal communication 15. Project staffing 16. Personnel training, career development, and evaluation 17. Meeting management 18. Build and motivate teams: Conflict resolution, Project Control, Change control, Reporting and monitoring, Analyse and measure project results, Recovery and correction, Reward and discipline, performance standards	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15%	

	• Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Schwalbe, Kathy, "Information Technology Project Management" 5th Edition, 2007 Bob Hughes and Mike Cotterell: Software Project Management, 4th Edition, McGraw-Hill 2005 Elaine Marmel: Microsoft Office Project 2003 Bible, Wiley Publishing Inc. Basics of Software Project Management, NIIT, Prentice-Hall India, 2004 Software Project Management in Practice, Pankaj Jalote, Pearson Education, 2002 Software Project Management, A Concise Study, S.A. Kelkar, Revised Edition, Prentice-Hall India, 2003

Module name	**Human Computer Interaction**
Module level	Undergraduate
Code	IF184601
Courses (if applicable)	**Human Computer Interaction**
Semester	6
Lecturer	Hadziq Fabroyir, S.Kom., Ph.D. (PIC) Ridho Rahman Hariadi, S.Kom., M.Sc. Siska Arifiani, S.Kom., M.Kom.
Language	Bahasa Indonesia and English
Relation to curriculum	Undergraduate degree program; compulsory. International undergraduate program; compulsory.
Type of teaching, contact hours	Undergraduate degree program: lectures, < 60 students, International undergraduate program: lectures, < 40 students

Teaching Methods	Lecture, lab works, project	
Workload	Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Design and Analysis Algorithm	
Course description	Human Computer Interaction (HCI) course focuses on interaction between human and computer design process, and the interface development. Interaction between human and computer takes place in the interface and involves software and hardware. Interface design affects software lifecycle. Design and implementation of core functions in the software affect user interface. Because it deals with people as well as computers, as a knowledge area HCI draws on a variety of disciplinary traditions including psychology, computer science, product design, anthropology and engineering. Through this course, students are expected to be able to apply human computer interaction principles on the software development as well as to do usability test on software and to report the result.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to discuss why software development centered on users is important.	PLO3, PLO8
	CO2 Students are able to develop and use modelling concept as well as feedbacks to analyze interactions between human and software.	PLO4, PLO6
	CO3 Students are able to define design process that focuses on user and to build a simple application including its user guide as well as documentation supporting user interaction.	PLO3, PLO4, PLO8, PLO9

	CO4 Students are able to create and conduct a usability test to software that they have developed, to evaluate it quantitatively (utility, efficiency, easiness, and satisfaction rate), and to report it.	PLO8, PLO9
	CO5 Students are able to report and discuss the development of the current trend of natural-user interfaces: Multi-touch based, gesture based, brain and muscle waves based interaction.	PLO6, PLO8, PLO9
Content	Basic principles of human, computer, and interaction paradigm. Basic principles of design process, modeling, and theory of human ccomputer interaction (HCI). Processes for user-centered development: early focus on users, empirical testing, iterative design Different measures for evaluation: utility, efficiency, learnability, user satisfaction. Physical capabilities that inform interaction design: color perception, ergonomics. Cognitive models that inform interaction design: attention, perception and recognition, movement, and memory. Gulfs of expectation and execution. Social models that inform interaction design: culture, communication, networks and organizations. Principles of good design and good designers; engineering tradeoffs. Accessibility: interfaces for differently-abled populations (e.g. blind, motion-impaired), interfaces for differently-aged population groups (e.g. children, 80+) 1. User interface standards 2. Help & documentation 3. Paper prototyping 4. GUI design principles 5. Assesment of current Natural User Interface technology.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: Two short computer-based quizzes: 15% x 2 = 30% Take-home written assignments: 15% Written midterm assessment: 25%	

	Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	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. Johnson, Jeff. Designing with the mind in mind: Simple guide to understanding user interface design rules. Morgan Kaufmann, 2010. Wigdor, Daniel, and Dennis Wixon. Brave NUI world: designing natural user interfaces for touch and gesture. Elsevier, 2011. Donald A. Norman. The Design of Everyday Things: Revised and Expanded Edition. Basic Books, 2013.

Module name	**Network Programming**	
Module level	Undergraduate	
Code	IF184602	
Courses (if applicable)	**Network Programming**	
Semester	6	
Lecturer	Hudan Studiawan, S.Kom., M.Kom., Ph.D. (PIC) Tohari Ahmad, S.Kom, M.IT, Ph.D	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Students learns how to create an application that able to communicate with other application in computer network using socket programming.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand and explain the concepts and principles of architecture, systems and the basics of computer networks based on logic systems.	PLO 2
	CO2 Students are able to understand and explain the concepts and principles of network-based computing and the latest technology related to it.	PLO 7

	CO3 Students are able to understand and explain the principles of making an algorithm and various programming language concepts.	PLO 2
	CO4 Students are able to understand and explain the application of network-based programming models to solve problems effectively and efficiently.	PLO 6, PLO 7
Content	1. SOCKET PROGRAMMING TECHNIQUES: TCP socket, UDP socket, string manipulation, socket option, TLS/SSL. 2. APPLICATION LAYER PROTOCOL: HTTP, SMTP, IMAP, POP, FTP 3. INPUT/OUTPUT MECHANISMS: I/O Model, Blocking I/O, Non-Blocking I/O, Signal Driven I/O, I/O Multiplexing, Asynchronous I/O. 4. DATA TRANSMISSION TECHNIQUES: Unicast, Broadcast, Multicast	
Media employed	LCD, whiteboard, websites, books (as references), etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final written exam (60 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final written exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• W. Richard Stevens, Bill Fenner, Andrew M. Rudoff,"Unix Network Programming Vol.1 3rd Edition", Addision Wesley, 2003. • Nathan Yocom, John Turner, Keir Davis," The Definitive Guide to Linux Network Programming" ,Appress, 2004.Pustaka • Elliotte Rusty Harold," Java Network Programming 3rd Edition", O'Reilly Media, 2004. • Brandon Rhodes, John Goerzen, "Foundations of Python Network Programming", Appress, 2013.	

Module name	**Requirement Engineering**
Module level	Undergraduate
Code	IF184603
Courses (if applicable)	**Requirement Engineering**
Semester	6
Lecturer	Daniel O. Siahaan, S.Kom. M,Sc, PD.Eng. (PIC) Dr. Umi Laili Yuhana, S.Kom., M.Sc. Nurul Fajrin Ariyani, S.Kom., M.Sc. Ratih Nur Esti Anggraini, S.Kom, M.Sc.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, project
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Analysis and Design of Information Systems
Course description	The students will learn about current advancement of methods, approaches, tools, and technologies in the fields of Requirements Engineering. Topics are chosen from a range of fields, such as requirements elicitation and discovery, requirements analysis, requirements specification, and requirements validation and verification.
	After completing this module, a student is expected to:

Learning outcomes and their corresponding PLOs	**CO1** Students are able to explain the basics of software requriements engineering.	PLO3
	CO2 Students are able to apply elicitation technique(s) to gather software requirements.	PLO3, PLO8, PLO9
	CO3 Students are able to model software requirements using a standard modeling language.	PLO3, PLO8, PLO9
	CO4 Students are able to documenting a formal software requirements specification based on a software development approach	PLO3, PLO8, PLO9
Content	Depending on the chosen topics, subjects in this unit may consist of knowledge and technologies on requirements elicitation and discovery, scenario, requirements analysis, UML, requirements specification, SMART requirements, requirements validation and verification.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	Daniel Siahaan, “Rekayasa Kebutuhan,” Penerbit Andi, 2012.

Module name	**Graph Theory and Automata**
Module level	Undergraduate
Code	IF184604
Courses (if applicable)	**Graph Theory and Automata**
Semester	6
Lecturer	Arya Yudhi Wijaya, S.Kom.,M.Kom. (PIC) Victor Hariadi, S.Si, M.Kom. Dr. Ahmad Saikhu, S,Si, MT.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Discrete Mathematics
Course description	In this course, students will learn the graph concept, data structure that represent the graph, modelling and optimization to resolve some cases of graphs. Several cases of optimization that can be solved with graph theory including determining the shortest path, minimum spanning tree, determination of the minimum route, scheduling, assignment problem, matching and optimization flow in network. The course of automaton will give the comprehensive knowledge of the background of developing some programming languages, give some lesson to construct a model which use an automaton as a tool. In along semester, the students will get comprehensive exercise to defining some objects or sets of objects which using recursive definitions, in personal or/and in team's exercises.

<table>
<tr><td rowspan="5">Learning outcomes and their corresponding PLOs</td><td>After completing this module, a student is expected to:</td><td></td></tr>
<tr><td>CO1 Students can know and understand graph theorems along with basic graph shapes</td><td>PLO5,
PLO7,
PLO9</td></tr>
<tr><td>CO2 Students can apply graph theory to the given real case studies</td><td>PLO5,
PLO7,
PLO9</td></tr>
<tr><td>CO3 Students can know and understand automata and their components</td><td>PLO5,
PLO7</td></tr>
<tr><td>CO4 Students can know and understand graph theorems along with basic graph shapes</td><td>PLO5,
PLO7</td></tr>
<tr><td>Content</td><td colspan="2">• Concepts of Graph:
- Graph & Simple Graph,
- Subgraph,
- Vertex Degree,
- Path & Connection,
- Cycles,
- Isomorphism,
- Tree,
- Directed Graph,
- Cut Edge & Cut Vertex,
- Spanning Tree,
- Types of Digraph & Their Connections,
- Fundamental Cycle,
- Special Graphs.
• Graphical representation of the structure of arrays, list, dan Standard Template Library (STL) in C/C++.
• Optimization of The Graph:
- Shortest Path,
- Minimum Spanning Tree,
- The Chinese Postman Problem,
- The Travelling Salesman Problem,
- Vehicle Routing Problem.
• Planar Graph:
- Region,
- Maximal Planar Graph,
- Crossing Number,
- Bipartite Graph,
- Graph Colouring,
- Chromatic Number.</td></tr>
</table>

	• Theory and Application Matching for Graph. • Theory and Application Network for Graph. • Language and Related Mathematical Operations: - Language Terminology - Operations on Language - The Methods for Defining Language - Regular Expression - Problem (Pumping Lemma) • Finite Automata - Deterministic Finite Automata (DFA) - Transition Graph - Automata with Output - Kleene Theorem - Non-Deterministic Finite Automata (NDFA) - DFA to NDFA Converting - Pushdown Automata (PDA) • Grammar - Grammar - Derivation dan Parse Tree - Grammar Classification - Context-Free Language (CFL) - CFL Transformation - Computability Theory - Turing Machine - Non-Deterministic Turing Machine - Church-Turing Thesis - Decidability - Reducibility • Computability Theory - Time Complexity for NP-Complete - Space Complexity for NP-Complete
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.

Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Diestel, R., Graph Theory, 2000, Springer-Verlag Vasudev Graph Theory with Application, 2006, New Age International Publisher McHugh, J.A., Algorithmic Graph Theory, 1990, Prentice-Hall Inc. Liotta, G., Tamassia, R., Tollis, I., Graph Algorithms and Applications 2, 2004, World Scientific Pub. Introduction to the Theory of Computation, 3rd Edition, Cencage Learning, 2013 Automata, Computability, and Complexity: Theory and Applications, Pearson International Edition, 2009

Module name	**Framework Based Programming**	
Module level	Undergraduate	
Code	IF184605	
Courses (if applicable)	**Framework Based Programming**	
Semester	6	
Lecturer	Fajar Baskoro, S.Kom., M.T. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; mandatory; 6th or 8th semester. 2. International undergraduate program; mandatory; 6th or 8th semester.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Object Oriented Programming	
Course description	In this course students learn basic concept on framework design and utilize frameworks that are available on the markets. Students can use frameworks on software projects effectively and efficiently. The use of frameworks will be adjusted according to the context of the software projects. Students can identify framework needs, constraints, advantages, and disadvantages from the time and cost perspectives. Students can also design and implement software by taking framework into account. Moreover, students can modify and add new functionalities on the existing frameworks in order to suit our need.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to explain framework programming concept.	PLO7
	CO2 Able to analyze problems using framework approach.	PLO3

	CO3 Able to model problem solution using framework approach.	PLO7
	CO4 Able to implement programming solutions to a problem using framework technology.	PLO3, PLO7, PLO9, PLO10
Content	1. Basic concept of framework; framework design methodology; principle of abstraction; differences between library and framework. 2. DRY (don't repeat yourself) principle; simple case study on software development without framework (from scratch); simple case study on software development using framework. 3. Frameworks on web platforms; frameworks on mobile platforms; frameworks on game platforms; frameworks on desktop platforms. 4. Framework trade-offs on speed, line of code, learning curve, reduced flexibility, performance of software. 5. Establish a software project and identify suitable frameworks based on requirement definition and software design. 6. Reviewing framework documentation; analysing constraints on selected frameworks. 7. Minimizing overlap among frameworks on a software; optimizing the use of several frameworks altogether; code writing convention; several software architecture adapted in framework design. 8. Analysing extension points in a framework; adding new functionality that is not provided by the existing framework on a context of software being done.	
Study and examination requirements and forms of examination	Mid-terms examination and Final examination.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	Cwalina, K., Abrams, B., “Framework Design Guidelines: Conventions, Idioms, and Patterns for Reusable .NET Libraries 2nd Edition”, Addison- Wesley, Boston, 2008 McConnell, S., “Code Complete: A Practical Handbook of Software Construction, 2nd Edition”, Microsoft Press, Redmond, 2004

Module name	**Information and Network Security**	
Module level	Undergraduate	
Code	IF184701	
Courses (if applicable)	**Information and Network Security**	
Semester	7	
Lecturer	Dr. Baskoro Adi P., S.Kom.,M.Kom. (PIC) Tohari Ahmad, S.Kom, M.IT, Ph.D. Wahyu Suadi, S.Kom, M.Kom.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Students learn techniques of information security that are stored inside computers and how to create a secure program.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand various encryption methods and apply them in appropriate circumstances	PLO2, PLO6, PLO7, PLO9
	CO2 Students are able to understand various cryptographic hash function and apply them in appropriate circumstances	PLO2, PLO6, PLO7, PLO9

	CO3 Students are able to understand the usage of Message Authentication Code and Digital Signature	PLO2, PLO7
	CO4 Students are able to look for vulnerabilities in web-based applications and know how to fix them	PLO2, PLO7
	CO5 Students are able to look for buffer overflow vulnerabilities in desktop applications and know how to fix them	PLO2, PLO7
Content	1. BASIC CONCEPT OF SECURITY: security property (confidentiality, integrity, availability, etc.) 2. BASIC OF ENCRYPTION: Number theory. 3. ENCRYPTION ALGORITHM: Classic encryption, block, stream, symmetric, asymmetric. 4. DATA INTEGRITY: Hash function, Message Authentication Code, Digital Signature, Digital Certificate, Public Key Infrastructure 5. SECURE CODING: String vulnerability, buffer overflow, SQL injection, dynamic memory management, etc.	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	CO1: Problem 1 in mid-term exam (5%) and exercise 1 (5%) - 10% CO2: Problem 2 in mid-term exam (5%) and exercise 2 (5%) - 10% CO3: Problem 3 in mid-term exam (5%); problem 4 in mid-term exam (15%); assignment 1: make an algorithm and computer program (5%); and exercise 3 (10%) and exercise 6 (5%) - 40% CO4: Problem 5 in mid-term exam and final exam (10%); problem 1 in final exam (5%) exercise 4 (5%) and assignment 3: make a program based on a real-life problem (5%) - 25% CO5: Problem 2 in final exam (5%); assignment 2: make a function and recursive (5%); and exercise 5 (5%) - 15%	
Study and examination requirements and forms of examination	Mid-term examination and Final examination. Students must have a final grade of 55.6% or higher to pass.	
Reading List	Elementary Linear Algebra; Howard Anton, Drexel University, John Wiley & Sons, Inc; ninth edition, 2005 Elementary Linear Algebra - Applications Version; Howard Anton, Chris Rorres; John Wiley & Sons, Inc; ninth edition, 2005	

Module name	**Undergraduate Pre-Thesis**	
Module level	Undergraduate	
Code	IF184702	
Courses (if applicable)	**Undergraduate Pre-Thesis**	
Semester	7	
Contact person	Ary Mazharuddin, S.Kom, M.Comp.Sc, PhD	
Lecturer	Ary Mazharuddin, S.Kom, M.Comp.Sc, PhD	
Language	Bahasa Indonesia and English	
Relation to curriculum	• Undergraduate degree program; compulsory; 7th semester. • International undergraduate program; compulsory; 7th semester.	
Type of teaching, contact hours	• Undergraduate degree program: Lectures, < 250 students • International undergraduate program: Lectures, < 200 students	
Workload	• Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. • Exercises and Assignments: 2x60=120 minutes (2 hours) per week. • Private study:2 x 60 = 120 minutes (2 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.	
Mandatory prerequisites	Student has passed Evaluation I and II	
Course description	Students are expected to explore ideas for their final project by engaging with a lecturer to discuss the idea. Students prepare a final project proposal in the semester where the pre-final project courses are taken.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Writing a proposal to apply the knowledge obtained during the study.	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO7, PLO8, PLO9, PLO10
	CO2 Literature study on research topics	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6,

		PLO7, PLO8, PLO9, PLO10
	CO3 Defining research problem	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO7, PLO8, PLO9, PLO10
Content	In this course, students will study and implement the stages in conducting research. Students learn to make Final Project proposals and make research documentation in the form of Final Project reports	
Study and examination requirements and forms of examination	• Quiz 1 and 2 • Assignment 1, 2, 3 • Mid-term examination • Final examination	
Media employed	LCD, whiteboard, PC, websites, books (as references), etc.	
Assessments and Evaluation	Observation from Supervisor, Final Project Seminar, Scientific writing (Final Project Book)	
Study and examination requirements and forms of examination	The final grade in the module is composed of: 1. Quiz 1 and 2 : 2 x 10% = 20% 2. Assignment 1, 2, 3: 3 x 5% = 15% 3. Mid-term examination: 30% 4. Final examination: 35% Students must have a final grade of 55.6% or higher to pass.	
Reading List	1. Guidelines for Writing Final Project Book	

Module name	**Internship**	
Module level	Undergraduate	
Code	IF184801	
Courses (if applicable)	**Internship**	
Semester	8	
Contact person	Ary Mazharuddin, S.Kom, M.Comp.Sc, PhD	
Lecturer	Ary Mazharuddin, S.Kom, M.Comp.Sc, PhD	
Language	Bahasa Indonesia and English	
Relation to curriculum	• Undergraduate degree program; compulsory; 7th, or 8th semester. • International undergraduate program; compulsory; 7th, or 8th semester.	
Type of teaching, contact hours	• Undergraduate degree program: supervised practical working/internship, < 250 students, • International undergraduate program: supervised practical working/internship, < 200 students	
Workload	supervised practical working/internship (8 hours/day) during 1 or 2 months	
Credit points	2 credit points (sks).	
Requirements according to the examination regulations	1. Internship must be done in an institution/working unit.	
Mandatory prerequisites	-	
Course description	An internship aims to help train and provide work experience to students. Students can gain skills that can be applied to future jobs. Internships may be paid or unpaid, and last from three to six months. While completing the internship program, students can also increase their communication, organizational and teamwork skills, all of which will come in handy in future positions.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Implementing knowledge with best practices on the field	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO7, PLO8, PLO9, PLO10

Content	In this course, students will study and implement the stages in solving problems of the real case study. Students learn to apply their knowledge and make project documentation in the form of an internship report.
Media employed	LCD, PC, whiteboard, websites, books (as references), etc.
Assessments and Evaluation	Final project presentation which will be evaluated by internal (BIP) and external supervisors.
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Discipline and attendance: 10% • Daily assignments: 20% • Final oral exam: 30% • Final report: 40% Students must have a final grade of 55.6% or higher to pass.
Reading List	G. L. McDowell, *Cracking the Coding Interview: 189 Programming Questions and Solutions*. CareerCup, LLC, 2015.

Module name	**Undergraduate Thesis**	
Module level	Undergraduate	
Code	IF184802	
Courses (if applicable)	**Undergraduate Thesis**	
Semester	8	
Contact person	Ary Mazharuddin, S.Kom, M.Comp.Sc, PhD	
Lecturer	Ary Mazharuddin, S.Kom, M.Comp.Sc, PhD	
Language	Bahasa Indonesia and English	
Relation to curriculum	• Undergraduate degree program; compulsory; 7th, or 8th semester. • International undergraduate program; compulsory; 7th, or 8th semester.	
Type of teaching, contact hours	• Undergraduate degree program: Supervised research activity, < 250 students, • International undergraduate program: Supervised research activity, < 200 students	
Workload	Supervised research activity: 4 x 50 = 200 minutes (3 hours 20 minutes) per week.	
Credit points	4 credit points (sks).	
Requirements according to the examination regulations	1. A student must have obtained an EFL score ≥ 477. 2. A student must have submitted a revised version of Final Project Proposal	
Mandatory prerequisites	A student must have completed a minimum study load of 118 SKS (including compulsory activities credits in semester 3 to semester 6 and have passed 2 credits of Pre-Final Project course) with an achievement index ≥ 2.0 without an E grade and without a D grade for certain subjects.	
Course description	Students and supervisors carry out supervision after the final project proposal is approved. The duration of the final project is a minimum of three months and a maximum of one year starting from the approval of the final project proposal. If the final project is more than one year, the final project expires. Students are required to retake a new final project topic by following the same procedure. It is possible to change the title of the final project under special conditions and only with the approval of the supervisor and/or management.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 FINAL PROJECT MATERIAL (Design, Analyze, Test and Demo Application)	PLO1, PLO2, PLO3, PLO4,

		PLO5, PLO6, PLO7
	CO2 MATERIALS (Question Answering Accuracy)	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO7
	CO3 PRESENTATION ABILITY (Communication, Time Control, Presentation)	PLO8, PLO9, PLO10
	CO4 FINAL PROJECT BOOK WRITING AND POMITS (Format, Typo, Reference, Table/Picture, Completeness)	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6, PLO7
Content	In this course, students will study and implement the stages in conducting research. Students learn to do research in the form of a Final Project and make research documentation in the form of a Final Project report.	
Study and examination requirements and forms of examination	• Observation from Supervisor • Final Project Seminar • Scientific writing (Final Project Book)	
Media employed	LCD, whiteboard, PC, websites, books (as references), etc.	
Assessments and Evaluation	Observation from Supervisor, Final Project Seminar, Scientific writing (Final Project Book)	
Study and examination requirements and forms of examination	The final grade in the module is composed of: 1. Observation from Supervisor: 30% 2. Final Project Seminar: 30% 3. Scientific writing (Final Project Book): 40% Students must have a final grade of 55.6% or higher to pass.	
Reading List	2. Guidelines for Writing Final Project Book 3. Curriculum Team of Bachelor Of Informatics Program, Department of Informatics, ITS.	

Wawasan dan Aplikasi Teknologi (WASTEK)

Insights and Applications of Technology (IAT)

Program Studi / Name of Study Program	Mata Kuliah Wajib Umum / *General Compulsory Course*
Mata Kuliah / Course	Wawasan dan Aplikasi Teknologi (WASTEK) / Insights and Applications of Technology (IAT)
Kode MK / Course Code	UG184916
Semester	➢ 5
Sks / Credits	3 SKS
Dosen Pengampu / Lecturer	Tim Dosen WASTEK / Lecturer Team on Insight and Application of Technology (IAT)

Bahan Kajian: ***Course Materials:***	Adapun materi dari mata kuliah Wawasan dan Aplikasi Teknologi adalah 1. Pengantar, RPS, Sillabus WASTEK, Teori Sistem dan Berpikir Sistemik 2. Pengetahuan Roadmap Riset ITS dan Nasional 3. Konsep SDGs (Sustainable Development Goals) 4. Pengantar dan Pengetahuan Science Technopark (STP) 5. Konsep dan Pengetahuan Kreatif, Inovatif 6. Teknologi Open Source 7. Konsep Proposal Program Kreatif Mahasiswa (PKM) The material from the Technology Insights and Applications course are 1. *Introduction, RPS, Sillabus WASTEK, Systems Theory and Systemic Thinking* 2. *ITS and National Research Roadmap Knowledge*
	3. *The concept of SDGs (Sustainable Development Goals)* 4. *Introduction to Science and Technopark Knowledge (STP)* 5. *Creative, Innovative Concepts and Knowledge* 6. *Open Source Technology* 7. *Concept of Student Creative Program Proposal (PKM)*

Learning Outcomes	1. Mampu bekerjasama dan memiliki kepekaan sosial, serta kepedulian terhadap masyarakat dan lingkungan, 2. Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya 3. Mampu menggunakan Aplikasi Teknologi untuk pengembangan atau implementasi ilmu pengetahuan teknologi berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, dan gagasan 4. Mampu menyusun Laporan akhir/Proposal atau proyek riset/inovasi/Program Kreatifitas Mahasiswa (PKM). *1. Able to cooperate and have social sensitivity, as well as concern for the community and the environment,* *2. Able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with their field of expertise* *3. Able to use Technology Applications for the development or implementation of scientific technology based on scientific principles, procedures and ethics in order to produce solutions and ideas.* *4. Able to compile final reports / proposals or research / innovation projects / Student Creativity Program (PKM).*
Capaian Pembelajaran Mata Kuliah (CPMK) ***Course Learning Outcome (CLO)***	1. Mampu Berfikir secara Sistematis dalam menyelesaikan permasalahan umum dengan baik dan 2. benar Mahasiswa Mampu mendayagunakan Pusat-Pusat 3. penelitian baik lokal maupun nasional dengan Aplikasi Teknologi Mampu memiliki wawasan konservasi terhadap sumber daya alam dan manusia dalam menerapkan ilmu pengetahuan dan teknologi untuk kepentingan

	Pembangunan Berkelanjutan dengan Teori dan Konsep SDG's. 4. Mampu menyelesaikan pembuatan Proposal Program Kreativitas Mahasiswa (PKM) dan program sejenis dalam menyiapkan project based inovasi beserta Luaran Proposal PKM (Artikel , Poster dan Video). *Able to think systematically in solving general* *1. problems properly and correctly* *2. Students Able to utilize research centers both local and national with technology applications* *3. Able to have insight into the conservation of natural and human resources in applying science and technology for the benefit of Sustainable Development with SDG Theory and Concept.* *4. Able to complete the making of Student Creativity Program (PKM) Proposals and similar programs in preparing innovation-based projects along with PKM Proposal Outputs (Articles, Posters and Videos).*

Bobot Penilaian /*Assess-ment Load* (%):

1. Evaluasi 1 / *Evaluation 1* : 10 % (tugas Individu / *Individual task*)
2. Evaluasi 2 / *Evaluation 2* : 20 % (UTS / *Midterm exam*)
3. Evaluasi 3 / *Evaluation 3* : 30 % (Pembuatan Proposal PKM / *PKM Proposal*)
4. Evaluasi 4 / *Evaluation 4* : 10 % (Pembuatan Artikel PKM / *PKM Article*)
5. Evaluasi 5 / *Evaluation 5* : 10 % (Pembuatan Poster PKM / *PKM Poster*)
6. Evaluasi 6 / *Evaluation 6* : 20% (Pembuatan Video PKM / *PKM Video*)

Pustaka / *References* :

Utama / M*ain*:

1. Akhmad Hidayatno, "BERPIKIR SISTEM", Pola Pikir Untuk Pemahaman Masalah Yang Lebih baik. 2016. Universitay of Indonesia.
2. Buku Tim Pengembang Mata Kuliah Wawasan Teknologi dan Komunikasi Ilmiah , "Wawasan Teknologi & Komunikasi Ilmiah", ITS Press, Surabaya, 2015.
3. Alfred Watkins and Michel Ehst, "Science, Technology and Innovation: Capacity Building for Sustainable Growth and Poverty Reduction", The International Bank for Reconstruction and Development, Washington DC, 2008.
4. Frieder Meyer Krahmer, "Innovation and Sustainable Development-Lesson for Innovation Policies, " A Springer-Verlag Company, Heidelberg, 1998.
5. Buku : ARAHAN Pelaksanaan Tujuan Pembangunan Berkelanjutan/SDGsTeam Leader Sekretariat SDGs Kementerian PPN/Bappenas, 1 Februari 2018, Alamat Kontak: Website : sdgs.bappenas.go.id

Module name	**Mobile Device Programming**	
Module level	Undergraduate	
Code	IF184901	
Courses (if applicable)	**Mobile Device Programming**	
Semester	7	
Lecturer	Dwi Sunaryono, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; optional; 7th semester. 2. International undergraduate program; optional; 7th semester.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	4 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Object Oriented Programming	
Course description	In this course, students will learn how to build mobile device applications using Android platform. The students understand the concept and technical aspect of the development of mobile device application.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students have an understanding of mobile device programming, are able to implement various platforms on mobile devices, are able to use JavaScript, AJAX on mobile devices and use standard templates, are able to create mobile web pages on smartphone browsers, are	PLO1

	able to use bandwidth saving techniques, are able to use bandwidth saving techniques	
	CO2 Students understand the concept of mobile programming with various platforms	PLO1, PLO6, PLO7
	CO3 Students are able to make programs on medium-scale android devices (SQLite), both individually and in teamwork	PLO6, PLO7, PLO8, PLO9, PLO10
	CO4 Students are able to create large-scale mobile programs with sensors and connect to servers	PLO6, PLO7, PLO8
Content	Android basics: building hello world application, adding the Action Bar, supporting different devices, managing the activity lifecycle, building a dynamic UI with fragments, saving data. Content sharing: sharing simple data, sharing files. Multimedia: managing audio playback, capturing photos. Connectivity: performing network operations, syncing to the cloud.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	Beginning Smartphone Web Development, Gail Rahn Frederick with Rajesh Lal, Appress, 2009 Hello, Android, Introducing Google's, Mobile Development Platform, 2nd Edition, Ed Burnette, The Pragmatic Bookshelf, Raleigh, North Carolina Dallas, Texas, 2009	

Module name	**Development and Analysis Algorithm**	
Module level	Undergraduate	
Code	IF184902	
Courses (if applicable)	**Development and Analysis Algorithm**	
Semester	6	
Lecturer	Rully Sulaiman, S.Kom., M.Kom.	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; optional; 6th semester. 2. International undergraduate program; optional; 6th semester.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Design and Analysis Algorithm	
Course description	In this course students will learn about optimal abstraction from real problems with medium and hard complexity level. Students are also able to implements the abstraction into design of algorithms with regards to correctness and efficiency using formal representation. In the end, students also able to present whole steps in design and analysis of algorithms systematically, both in written and verbal.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to analyse and design algorithm correctly and efficiently	PLO7, PLO9

Content	1. Algorithm and complexity 2. Design and analysis of algorithm with divide and conquer paradigm: Binary search algorithm, Non-classical dynamic programming, Greedy algorithm 3. Representation of several advance data structures that related to dynamic programming: Tree segment structure (range min/max query, range sum query) and lazy propagation, Fenwick Tree (binary indexed tree), Splay tree 4. Design and analysis of algorithms in graph structures: Minimum spanning tree, All pair shortest path and single source shortest path, Strongly connected component, topological sort and 2-SAT problem, Maximum flow, minimum cut, and bipartite matching
Study and examination requirements and forms of examination	Mid-terms examination and Final examination.
Media employed	LCD, whiteboard, websites, books (as references), online meeting etc.
Assessments and Evaluation	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	• Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms Third Edition”, MIT Press, 2009 • Levitin, Anany, “Introduction to The Design & Analysis Af algorithms 3rd ed”, Addison-Wesley, 2012 • Robert Sedgewick, Kevin Wayne, Algorithms, 4th Edition, Addison Wesley, 2011 • Stephen Halim, Felix Halim, Competitive Programming, 3rd Edition, NUS School of Computing, 2013

Module name	**Interface Programming**	
Module level	Undergraduate	
Code	IF184903	
Courses (if applicable)	**Interface Programming**	
Semester	6 or 8	
Lecturer	Dwi Sunaryono, S.Kom., M.Kom. (PIC) Bilqis Amaliah, S.Kom, M.Kom. Yudhi Purwananto, S.Kom, M.Kom.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; mandatory; 6th, or 8th semester. 2. International undergraduate program; mandatory; 6th, or 8th semester.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Object Oriented Programming	
Course description	Interface-Based Programming course is designed to provide students with knowledge related to interfaces between programming languages, application to applications and server settings.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	Students understand the concepts and applications of interface programming	PLO1
	Students understand the concepts of interfaces with various platforms	PLO1, PLO6, PLO7
	Students are able to create interface program in a DBMS or noSQL, both individually and in teamwork	PLO6, PLO7, PLO8, PLO9, PLO10

	Students are able to make interface programs in multuplatform	PLO6, PLO7, PLO8
Content	1. Introduction to programming interface 2. Creating simple interface programs with CRUD and libraries 3. PHP-python interface program introduction 4. Using Postman-PHP-python 5. Creating a process with PHP-python 6. Learn Python-Machine Learning 7. Learn Server Settings 8. Python-Machine Learning Communication 9. Simple Object Recognition Case Study with Python-PHP-based Machine Learning 10. Case Study of Face Detection Recognition with Python-PHP-based Machine Learning 11. Case Study Introduction of General Image Detection with Python-PHP-based Machine Learning 12. Case Study Introduction of General Text Detection with Python-PHP-based Machine Learning 13. Application Testing with Postman-PHP-python-Machine Learning 14. Introduction to Parallel Processes in Machine Learning Models 15. Deployment using Flask	
Media employed	LCD, whiteboard, websites, books (as references), online meeting etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	• Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms Third Edition”, MIT Press, 2009 • Levitin, Anany, “Introduction to The Design & Analysis Af algorithms 3rd ed”, Addison-Wesley, 2012 • Robert Sedgewick, Kevin Wayne, Algorithms, 4th Edition, Addison Wesley, 2011 • Stephen Halim, Felix Halim, Competitive Programming, 3rd Edition, NUS School of Computing, 2013

Module name	**Wireless Networking**	
Module level	Undergraduate	
Code	IF184911	
Courses (if applicable)	**Wireless Networking**	
Semester	7	
Lecturer	Ary Mazharuddin Shiddiqi, S.Kom., M.Comp.Sc., Ph.D. (PIC) Dr. Eng. Radityo Anggoro, S.Kom, M.Eng.Sc.	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, projects	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Wireless Network is a part of the vast development of computer network technology. The use of wireless infrastructures provides mobility aspect in nearly everything. This course discuss many aspects of wireless network, particularly in infrastructure and technology.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 The students are able to apply concepts to various wireless network architectures to improve performance and provide solutions to wireless network problems.	PLO 2
	CO2 Students are able to apply concepts to projects related to wireless networks	PLO7

Content	1. Introduction of Wireless LAN and Cellular Network. 2. Antenna and Spectrum 3. Wireless LAN infrastructures 4. Wireless LAN standards 5. 802.11 architectures 6. Medium Access Control and Physcal Layer 7. Troubleshooting of wireless LAN 8. Security of Wireless LAN 9. Mobile Adhoc Network, Wireless Sensor Network 10. Adhoc network and Routing 11. Mobile IP concept 12. Mobile Transport Layer
Media employed	LCD, whiteboard, websites, books (as references), etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	1. Coleman, D., Westcott, D., "CWNA: Certified Wireless Network Administrator Official Study Guide", Wiley Publishing Inc., 2009. 2. Schiller, J.H., "Mobile Communications 2nd Edition", Addison- Wesley, 2004. 3. Stallings, W., "Wireless Communications and Networking 2nd Edition", Prentice Hall, 2004. 4. James F. Kurose and Keith W. Ross, Komputer Networking: A Top-Down Approach, 7th Edition, Addison Wesley, 2013.

Module name	**Internetworking Technology**	
Module level	Undergraduate	
Code	IF184912	
Courses (if applicable)	**Internetworking Technology**	
Semester	7	
Lecturer	Dr. Baskoro Adi Pratomo, S.Kom., M.Kom. (PIC) Ir. Muchammad Husni, M.Kom Bagus Jati Santoso, S.Kom., Ph.D.	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, projects	
Workload	Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	The purpose of this course is to allow students to understand the use of TCP / IP in the computer networks. In addition, this course also discusses the routing algorithm and its implementation. This unit will examine some routing protocols and its supporting devices, such as routers, switches, as well as the concept of IP v4 and IP v6.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	PLO2, PLO9
	CO1 Students are able to understand the concept of STP and VLAN and implement them	PLO2, PLO9
	CO2 Students are able to explain IPv6 basic concepts, migration approaches from IPv4, and its addressing	PLO2, PLO9

	method as well as implementing them in the real world	
	CO3 Students are able to understand and implement dynamic routing with RIP, OSPF, EIGRP, BGP and protocol redistribution	PLO2, PLO9
	CO4 Students are able to understand how VPNs work and to know the difference of a network running with a VPN and without	PLO2, PLO9
Content	Introduction to Inter-Networking Technologies: Understanding the purpose of lecture in networks technology, learning organization, Components & Evaluation Form; Subnetting & Static Routing: IP, CIDR, VLSM, NAT, Static Routing, CISCO IOS; Switching Layer 2: Switching services, Spanning Tree protocol, LAN Switch; Kinds of Dynamic Routing: Distance Vector Routing, Link State Routing; Virtual LANs: VLAN, VLAN Trunking Protocol, VLAN Routing, Configuration; Virtual Private Network: VPN, Configuration; Routing Information Protocol: RIPv1, RIPv2; Interior Gateway Routing Protocol: IGRP Timers, Configuration; Enhanced IGRP: Features, Neighbour Discovery, RTP, DUAL, AS; OSPF and IS-IS: Algorithms, Configuration; IP Traffic Engineering: Traffic, Network Flow Optimization, Shortest Path Routing and Network Flow, MCNF Duality; Border Gateway Protocol: Algorithms, Message Formats, Operations, Configuration; Internet Routing Architecture: Illustration, Architectural View of the Internet, Allocation of IP Prefixes and AS Number; Quality of Service Routing: QOS Attributes, Shortest Path and widest Path Routing, Source-based QOS Routing, QOSPF; IPv6: Terminology, Packet Format, Difference with IPv4, IPv4 to IPv6 Tunnelling PREREQUISIT	
Media employed	LCD, whiteboard, websites, books (as references), etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: Two short computer-based quizzes: 15% x 2 = 30% Take-home written assignments : 15% Written Midterm assessment: 25% Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	1. Todd Lammle, CCNA Study Guide, Third Edition, 2002 2. Deepankan Medhi, Karthikeyan Ramasamy, Network Routing Algorithms, Protocols, and Architectures, 2007

Module name	**Security Design of System and Network**	
Module level	Undergraduate	
Code	IF184913	
Courses (if applicable)	**Security Design of System and Network**	
Semester	8	
Lecturer	Dr. Baskoro Adi Pratomo, S.Kom., M.Kom.(PIC) Bagus Jati S, Ph.D. Ir. Muchammad Husni, M.Kom.	
Language	Bahasa Indonesia dan English	
Relation to curriculum	3. Undergraduate degree program; elective. 4. International undergraduate program; elective.	
Type of teaching, contact hours	4. Undergraduate degree program: lectures, < 60 students, 9. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, projects	
Workload	Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Information and Network Security	
Course description	Students learn advanced topics about software security, malicious software, malicious software analysis, and network security	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to explain the basic concept of computer security and user authentication.	PLO2, PLO9
	CO2 Students are able to explain various types of malware and to implement intrusion detection systems, firewalls, and honeypots for securing a system and collecting data.	PLO2, PLO6, PLO9

	CO3 Students are able to implement logging systems on Windows and Linux, and analyse the logs	PLO2, PLO6, PLO9
	CO4 Students are able to explain the concept of wifi and email security as well as the concept of Transport Layer Security	PLO2, PLO9
	CO5 Students are able to explain the concept of IT security management and the ethical and legal aspects of computer security	PLO2, PLO9
Content	SECURITY OF SOFTWARE: Email Security, User authentication Protocol (Kerberos, RADIUS, etc), and Web Application Firewall. MALICIOUS SOFTWARE ANALYSIS: Intrusion Detection System, Honeypot, Malware Analysis. NETWORK SECURITY: Routing Protocol, VPN, IPSec	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	Intrusion Detection Networks: A Key to Collaborative Security by Carol Fung and Raouf Boutaba (Nov 19, 2013) Cryptography and Network Security: Principles and Practice (6th Edition) by William Stallings (Mar 16, 2013). Network and System Security, Second Edition by John R. Vacca (Sep 23, 2013). Network Security Essentials: Applications and Standards (4th Edition) by William Stallings (Mar 22, 2010). Information Security The Complete Reference, Second Edition by Mark Rhodes-Ousley (Apr 3, 2013)	

Module name	**IoT Technology**	
Module level	Undergraduate	
Code	IF184914	
Courses (if applicable)	**IoT Technology**	
Semester	8	
Lecturer	Ary Mazharuddin Shiddiqi, S.Kom., M.Comp.Sc., Ph.D. (PIC) Ir. Muchammad Husni, M.Kom.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Students learns the concept of IoT technology and various applications working in the IoT environment.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Provides knowledge and implementation of wireless sensor networks and uses physical computational tools by developing a wider variety of computer devices that can be used in the physical environment.	PLO2, PLO9
	CO2 Knowing the dispersed technological developments and designed to operate the human and social environment in harmony.	PLO4, PLO7

Content	1. Ubiquitous Computing: Basics and Vision, Modelling the Key Ubiquitous Computing, Ubiquitous System Environment Interaction, Architectural Design for UbiCom Systems: Smart DEI Model; Smart Devices and Services: Service Architecture Models, Service Provision Life Cycle, Virtual Machines and Operating Systems; 2. Human–Computer Interaction: User Interfaces and Interaction for Four Widely Used Devices, Hidden UI Via Basic Smart Devices; Tagging, 3. Sensing and Controlling: Tagging the Physical World, Sensors and Sensor Networks, Micro Actuation and Sensing: MEMS, Embedded Systems and Real Time Systems, Control System and Robots; 4. Context-Aware Systems: Modelling Context Aware Systems, Mobility Awareness, Spatial Awareness, Temporal Awareness: Coordinating and Scheduling, ICT System Awareness. 5. Intelligent Systems (IS): Basic Concepts, IS Architectures, Semantic Knowledge Based IS, Classical Logic IS, Soft Computing IS Models, IS System Operations. 6. Ubiquitous Communication: Audio Networks, Data Networks, Wireless Data Networks. 7. Management of Smart Devices: Managing Smart Devices in Virtual Environments, Managing Smart Devices in Human User Centred Environments, Managing Smart Devices in Physical Environments
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.

Reading List	Stefan Poslad, Ubiquitous Computing Smart Devices, Environments, and Interaction, JohnWiley&Sons, Ltd., 2009 Frank Adelstein, Sandeep K. S. Gupta, Golden G. Richard III, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, McGraw-Hill, 2005

Module name	**Modelling and Simulation**	
Module level	Undergraduate	
Code	IF184921	
Courses (if applicable)	**Modelling and Simulation**	
Semester	8	
Lecturer	Prof. Dr. Ir. Joko Lianto Buliali, M.Sc (PIC) Dr. Ahmad Saikhu, S,Si, MT.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Probability and Statistics	
Course description	In this course, students learn concept & procedure in creating simulation model of a real system which the performance efficiency is under study, run a simulation model, draw conclusion on efficiency based on the analysis of simulation output, develop alternative system and compare performance based on the output of simulation run and the output of the real system, able to work individually and in a group.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 able to explain the concept of simulation, how simulation works, and under what circumstances simulation helps humans find solutions	PLO10
	CO2 able to explain the use of random number generator and random variable simulation model.	PLO5

	CO3 able to create a simulation model from the description of the problem given.	PLO9, PLO10
	CO4 able to use simulation tools to execute simulation models created	PLO5, PLO9
	CO5 able to analyze the output of the simulation execution results	PLO5, PLO9, PLO10
Content	• Modelling and Simulation Concepts • Modelling and Simulation Relationship • Probability Distribution and Visualization in Modelling and Simulation • Input Modelling • Output Analysis • Creating Simulation Model Using Simulation Tool	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	
Reading List	• Banks, J., John S. Carson II, "Discrete-Event System Simulation", Prentice Hall, 2009. • Law, A., "Simulation Modelling and Analysis", McGraw-Hill, 2006.	

Module name	**Multivariate Data Analysis**
Module level	Undergraduate
Code	IF184922
Courses (if applicable)	**Multivariate Data Analysis**
Semester	6
Lecturer	Dr. Ahmad Saikhu, S,Si, MT. (PIC) Prof. Dr. Ir. Joko Lianto Buliali, M.Sc.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Probability and Statistics
Course description	In this course, the student will learn about multivariate algebra, Multivariate Normal, Types of Univariat dan multivariate Methods, Multivariate Data Exploration/Multivariate Descriptive Analysis. Furthermore, students will be able to perform the modeling and analysis of the various methods of analysis multiariat, namely Multiple Dependent Models: MANOVA, PCA, and Canonical Analysis. Classification and Clustering: Cluster Analysis, Discriminant Analysis. Data Reduction: Factor Analysis. Perceptual Mapping: Multidimensional Scaling, Correspondence Analysis, Conjoint Analysis, and Structural Equation Modeling.
	After completing this module, a student is expected to:

<table>
<tr><td rowspan="4">Learning outcomes and their corresponding PLOs</td><td>CO1 Students can explain the differences in univariate and multivariate analysis.</td><td>PLO5</td></tr>
<tr><td>CO2 Students can use a variety of appropriate multivariate modelling analysis purposes.</td><td>PLO5</td></tr>
<tr><td>CO3 Students can analyse the results of the multivariate data processing.</td><td>PLO7,
PLO9</td></tr>
<tr><td>CO4 Students can use multivariate statistical data processing software.</td><td>PLO7,
PLO9</td></tr>
<tr><td>Content</td><td colspan="2">• The Basic Concept of Multivariate Data,
• Multivariate Algebra
• Multivariate Normal Mapping Techniques
• Univariate and Multivariate,
• Multivariate Data Exploration / Descriptive Multivariate Analysis
• Multiple Dependent Models: MANOVA, PCA, Canonical Analysis.
• Classification and Grouping: Cluster Analysis, Discriminant Analysis.
• Data Reduction Techniques: Factor Analysis.
• Perceptual Mapping: Multidimensional Scaling, Correspondence Analysis, Conjoint Analysis.
• Structural Equation Modelling: The Use of Tools</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td colspan="2">The final grade in the module is composed of:
• Two short computer-based quizzes: 15% x 2 = 30%
• Take-home written assignments: 15%
• Written midterm assessment: 25%
• Final oral exam: 30%

Students must have a final grade of 55.6% or higher to pass.</td></tr>
<tr><td>Media employed</td><td colspan="2">LCD, whiteboard, websites, books (as references), online meeting, etc.</td></tr>
<tr><td>Assessments and Evaluation</td><td colspan="2">One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.</td></tr>
</table>

Reading List	Barbara G. Tabachnick, Linda S. Fidell, “Using Multivariate Statistics”, 5th Edition, Pearson International Edition, 2007. Joseph F. Hair, Jr., William C. Black, “Multivariate Data Analysis”, 7th Edition, Pearson International Edition, 2010. Richard A. Johnson, Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Prentice Hall International Inc., 2007.

Module name	**Operational Research**
Module level	Undergraduate
Code	IF184923
Courses (if applicable)	**Operational Research**
Semester	7
Lecturer	Dr. Bilqis Amaliah, S.Kom, M.Kom (PIC) Yudhi Purwananto, S.Kom, M.Kom
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Linear Algebra
Course description	In this course, students learn how to modeling problems in the real world into the Linear Program modeling (LP). Students learn the LP material with 2 variables, studying the PL solution using graphs, LP solution using Excel Solver and TORA. Simplex method begins with the equation model PL then transition from graph to algebraic solution, for more complex problems using the M-method and two-phase method then continued with Sensitivity Analysis. Duality begins with the definition of the dual problem, then the relationship between the primal and the dual, followed by the economic interpretation of duality, additional simplex algorithm and post-optimal analysis. Transport model begins with the definition of the transport models, non-traditional transportation models, algorithms and models of transport assignments. Network model begins with the scope and definition of the network model, the minimum spanning tree algorithm, the shortest route problem, maximal flow models,

	CPM and PERT. Integer Linear Programming begins with illustrative examples of applications, integer programming algorithm and traveling salesmen. For each sub-topics will be implemented into the program.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand and explain the linear programming model	PLO5, PLO7
	CO2 Students are able to design and solve the transportation problems	PLO6, PLO7
	CO3 Students are able to design and solve the shortest route problem	PLO5, PLO6
	CO4 Students are able to design and analyze project control	PLO6, PLO7

Content	- Linear Program Modelling (LP):
	  - LP Model with 2 Variables,
	  - PL Solution using Graphs,
	  - LP Solution using Excel Solver and TORA.
	- Simplex Method and Sensitivity Analysis:
	  - Equation Model PL,
	  - Transition from Graph to Algebraic Solution,
	  - M-method and Two-phase Method continued with Sensitivity Analysis.
	- Duality dan Post-Optimal Analysis:
	  - Definition of The Dual Problem
	  - Relationship Between The Primal and The Dual
	  - Economic Interpretation of Duality
	  - Additional Simplex Algorithm
	  - Additional Post-Optimal Analysis
	- Transport Model and Variants:
	  - Definition of The Transport Models
	  - Non-traditional Transportation Models
	  - Algorithms And Models of Transport Assignments
	- Network Model:
	  - Scope And Definition of The Network Model,
	  - Minimum Spanning Tree Algorithm,
	  - Shortest Route Problem,
	  - Maximal Flow Models,
	  - CPM
	  - PERT.	

	- Integer Linear Programming;
	  - Illustrative Examples of Applications,
	  - Integer Programming Algorithm
	  - Traveling Salesmen.

Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Operation Research; Hamdy A. Taha, University of Arkansas, Prentice Hall; Eight Edition, 2007.

Module name	**Game Development Techniques**	
Module level	Undergraduate	
Code	IF184931	
Courses (if applicable)	**Game Development Techniques**	
Semester	7	
Lecturer	Imam Kuswardayan, S.Kom., MT (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Human and Computer Interaction	
Course description	This course aims to make students able to develop a computer game based on the basic theories of game development.At the beginning of this course students will learn about the history and development of game technology, some popular games, also game classifications based on genres, theme and others. The next stage will learn about the game development process, how to design a game, the game documentation (GDD), then learn about theory of fun in game and edutainment. Until the end of course, students with team will be able to implement game development.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Attendance	PLO8

	CO2 Student able to classify games	PLO3, PLO4
	CO3 able to design game design document	PLO3, PLO4, PLO8, PLO9
	CO4 able to develop game with team	PLO3, PLO4, PLO8, PLO9
Content	Game theory, game development process, game design document, interface design for game, game middleware, edutainment, theory of fun.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Arnest Adam, “Fundamentals of Game Design”, New Riders Press, 2nd Edition 2010	

Module name	**Virtual and Augmented Reality**	
Module level	Undergraduate	
Code	IF184932	
Courses (if applicable)	**Virtual and Augmented Reality**	
Semester	7	
Lecturer	Hadziq Fabroyir, S.Kom., Ph.D. (PIC) Dr.Eng. Darlis Heru Murti, S.Kom., M.Kom.	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Human and Computer Interaction.	
Course description	This course discusses aspects related to the development of virtual reality and augmented reality application, input and output elements that is used in the virtual reality, optical modeling to produce stereoscopic view, and virtual reality programming.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand XR theory comprehensively in terms of not only software but also hardware.	PLO8, PLO9
	CO2 Students are able to design and build a basic virtual environment, to apply a good interaction, also to work on 3D modelling.	PLO4, PLO9

	CO3 Students are able to design a gamification to improve the mental immersion on XR applications.	PLO4, PLO6
	CO4 Students are able to develop 3D XR applications both individually and in team.	PLO3, PLO8, PLO9
Content	1. In-game computing, simulation games, multiplayer games, social games, economy games	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Grigore, C Burdea & Philippe, Coiffet, "Virtual Reality Technology", Wilye Interscience, 2003. • William R. Sherman, Alan B.Craig, "Understanding Virtual Reality", Morgan-Kaufmann, Inc., 2003.	

Module name	**Game System**	
Module level	Undergraduate	
Code	IF184933	
Courses (if applicable)	**Game System**	
Semester	7	
Lecturer	Imam Kuswardayan, S.Kom., MT (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Human Computer Interaction	
Course description	In this course, students will learn about various aspect required to develop complex game. The students will study about serious game, simulation game, game computation, network for game, multiplayer game, social game and game economy.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Attendance	
	CO2 Education Game review	PLO1

	CO3 Analysis of Simulation Game process	PLO1, PLO3
	CO4 Developing of Simple Education Game	PLO1, PLO3, PLO4, PLO9
	CO5 Developing Simulation Game	PLO1, PLO3, PLO4, PLO9
Content	1. Game computation, simulation game, multiplayer game, social game, game economy.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Social Game Design, Monetization Methods and Mechanics, Tim Fields 2012 • Theory of Fun for Game Design, Ralph Koster, 2nd Edition Nov 2013 • David Michael, “Serious Games, Games that Educate, Train and Inform”, Thomson Course Tech, Canada, 2005	

Module name	**Computer Animation and 3D Modeling**	
Module level	Undergraduate	
Code	IF184934	
Courses (if applicable)	**Computer Animation and 3D Modeling**	
Semester	8	
Lecturer	Siska Arifiani, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Graphics	
Course description	In this course, students study the basic concepts and programming techniques in 3D modeling and animation. Students will have experience to create 3D models and simple animation using graphics programming tools. In addition, students can also explain the state of the art in the field of advanced 3D modeling and animation	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Understand research trend in Interactive Computer Graphics	PLO4, PLO9
	CO2 Understand tools in animation and 3D Modelling	PLO4, PLO9

	CO3 Understand 3D process modelling	PLO4, PLO9
	CO4 Understand Computer Animation Process	PLO4, PLO9
Content	1. Theory of computer animation, Polygonal Meshes, Basic animation techniques, Advanced animation techniques: physical-based simulation, physically-based character simulation.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, 7th edition, Addison Wesley, 2012. • Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Introduction to Algorithms, McGraw-Hill, 2003.	

Module name	**Intelligence Game**	
Module level	Undergraduate	
Code	IF184935	
Courses (if applicable)	**Intelligence Game**	
Semester	6	
Lecturer	Dr.Eng. Darlis Herumurti, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Method	Lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 240 minutes (3 hours) per week. 3. Private study: 3 x 60 = 240 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Human Computer Interaction	
Course description	In this course, students will learn about various aspect required to develop complex game. The students will study about serious game, simulation game, game computation, network for game, multiplayer game, social game and game economy	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to design intelligent game development	PLO1
	CO2 Students understand the concept of learning for NPCs in intelligent games	PLO1

	CO3 Students are able to implement learning methods using unity ML-AGENT	PLO1, PLO4, PLO9
	CO4 Students are able to develop intelligent game	PLO1, PLO4, PLO9
Content	1. Game computation, simulation game, multiplayer game, social game, game economy.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: Two short computer-based quizzes: 15% x 2 = 30% Take-home written assignments : 15% Written Midterm assessment: 25% Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Social Game Design, Monetization Methods and Mechanics, Tim Fields 20124 • Theory of Fun for Game Design, Ralph Koster, 2nd Edition Nov 2013 • David Michael, “Serious Games, Games that Educate, Train and Inform”, Thomson Course Tech, Canada, 2005	

Module name	**Multimedia Network**	
Module level	Undergraduate	
Code	IF184941	
Courses (if applicable)	**Multimedia Network**	
Semester	8	
Lecturer	Dr.Eng. Radityo Anggoro, S.Kom., M.Sc. (PIC) Henning Titi Ciptaningtyas, S.Kom, M.Kom	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Network	
Course description	In this course, the students will understand the concepts and procedures of the delivery of multimedia data (text, images, sound, and video). The multimedia data should be delivered in optimal and secure way. The students should perform the task individually and in groups. Materials of the course include the basics of multimedia and their representation, multimedia data compression to make them small enough to be distributed over a network, and securing multimedia data transmission over the network.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 The students are able to apply concepts & procedures in sending multimedia data (text,	PLO 2, PLO 9

	images, sound, and video) in the network optimally and safely both individually and in groups in teamwork.	
Content	1. Basic multimedia: text, image, audio, video. 2. Multimedia representation and multimedia compression. 3. Multimedia network 4. Multimedia distribution 5. Multimedia security	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Henning Titi Ciptaningtyas,"Bahan Ajar Jaringan Multimedia",http:\\share.its.ac.id,2013, IF-ITS. • Jeniq-Neng Hwang, "Multimedia Networking From Theory to Practice", Cambridge, 2013. ISBN 9780521882040. • Ze-Nian Li and Mark. S. Drew, "Fundamentals of Multimedia", Prentice-Hall, 2003. ISBN 0130618721. • W.C. Hardy,"QoS Measurement and Evaluation of Telecommunications Quality of Service", Wiley, 2001. ISBN 0470845910.	

Module name	**Cloud Computing**	
Module level	Undergraduate	
Code	IF184942	
Courses (if applicable)	**Cloud Computing**	
Semester	7	
Lecturer	Dr. Eng. Royyana Muslim I, S.Kom, M.Kom (PIC) Bagus Jati Santoso, S.Kom., Ph.D.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Cloud computing is a new paradigm in the information technology services industry. Cloud computing technology orientates to the user in terms of services, the provision of computing resources in a transparent manner. This course will discuss the basic and the introduction of cloud technologies, mechanisms, and architecture along with the latest technology and research in cloud computing (OGSA).	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the definition, and essential characteristics of cloud computing as well as their key components	PLO2, PLO9

	CO2 Students are able to design application composition to meet the essential characteristics of cloud computing	PLO2, PLO9
	CO3 Students are able to design cloud computing services on certain level with the accordance to the cloud computing service models	PLO2, PLO9
	CO4 Students are able to deploy own application design into cloud computing infrastructure either public/private	PLO2, PLO9
Content	1. Concept and Model: Technology, Security 2. Cloud Characteristic: Limitation, on Usage, Ubiquitous Access, Multitenancy, Elasticity, Measured Usage 3. Delivery Model: IaaS, PaaS, SaaS 4. Deployment: Public, Community, Private, Hybrid 5. Technology: Internet, Data Center, virtualization, Web, Service, Multitenancy, Cloud infrastructure software 6. Cloud Computing Security -- Threat, Cloud Security Threats 7. Cloud Computing Security Mechanism-- Public Key Infrastructure, Hashing, Digital Signature, SSO, Virtual Server 8. Architecture - Workload Distribution, Resource Pooling, Dynamic Scalability 9. Architecture - Elastic Resource Capacity, Service Load Balancing, Cloud Bursting.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	Thomas Erl et al, “Cloud Computing, Concepts, Technology. And Architecture”. Prentice Hall. Hill et al, “Guide to Cloud Computing, Principles and Practice”. Springer.Jeniq-Neng Hwang, “Multimedia Networking From Theory to Practice”, Cambridge, 2013. ISBN 9780521882040. Ze-Nian Li and Mark. S. Drew, “Fundamentals of Multimedia”, Prentice-Hall, 2003. ISBN 0130618721. W.C. Hardy,”QoS Measurement and Evaluation of Telecommunications Quality of Service”, Wiley, 2001. ISBN 0470845910.

Module name	**Mobile Computing**	
Module level	Undergraduate	
Code	IF184943	
Courses (if applicable)	**Mobile Computing**	
Semester	7	
Lecturer	Dr.Eng. Radityo Anggoro, S.Kom., M.Sc. (PIC) Hudan Studiawan, S.Kom., M.Kom.,Ph.D. Baskoro Adi Pratomo S.Kom, M.Kom.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Students learn the concept of mobile computing and various applications working in the mobile environment, mobile ad hoc and delay tolerant networks.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand general concepts and problems of system development in a mobile computing environment	PLO2, PLO9
	CO2 Students are able to understand the characteristics of systems in a mobile environment in designing applications to work in a mobile computing environment	PLO2, PLO8

	CO3 Students are able to understand location management and its influence on system behavior in a mobile computing environment explaining its limitations	PLO2, PLO6
	CO4 Students are able to work together in teams to build system prototypes that can work in a mobile environment and communicate ideas and prototypes built by the team.	PLO2, PLO8
Content	1. Wireless network and its limitation 2. Characteristics and system dimension which works in a mobile environment 3. Mobility modelling and characterizing in a mobile environment 4. Location management by a system in a mobile environment 5. Ad hoc and delay tolerant networks along with their strengths and weaknesses 6. Mobile information access problems and application adaptation relates to energy, resource availability etc 7. Spontaneous networking, mobile peer-to-peer and its application 8. Routing in ad hoc and delay tolerant networks · Mobile computing related-issues	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	Abdessalam Helal, Et.Al," Anytime, Anywhere Computing, Mobile Computing Concepts and Technology" , McGraw-Hill. Mobile Computing Principles Designing And Developing Mobile Applications With Uml And Xml and the Environment", Oxford Publisher 2002. Location Management and Routing in Mobile Wireless Networks,Amitava Mukherjee, Somprakash Bandyopadhyay, Debashis	

	Saha, Artech House Publisher. Andreas Heinemann, Max Muhlhauser", Peer-to-Peer Systems and Application. Mohammad Ilyas and Imad Mahgoub, Mobile Computing Handbook, Auerbach PublicationHill et al, “Guide to Cloud Computing, Principles and Practice”. Springer.Jeniq-Neng Hwang, “Multimedia Networking From Theory to Practice”, Cambridge, 2013. ISBN 9780521882040. Ze-Nian Li and Mark. S. Drew, “Fundamentals of Multimedia”, Prentice- Hall, 2003. ISBN 0130618721. W.C. Hardy,”QoS Measurement and Evaluation of Telecommunications Quality of Service”, Wiley, 2001. ISBN 0470845910.

Module name	**Distributed System**	
Module level	Undergraduate	
Code	IF184944	
Courses (if applicable)	**Distributed System**	
Semester	7	
Lecturer	Royyana Muslim Ijtihadie, S.Kom., M.Kom., Ph.D. (PIC) Ary Mazharuddin Shiddiqi, S.Kom. M.Comp.Sc. Ph.D.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 240 minutes (3 hours) per week. 3. Private study: 3 x 60 = 240 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	This course discuss about how to coordinate processes on many computer connected via fast local network or slow network to achieve a single purpose.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Student are able to explain the characteristics of distributed system and its architecture	PLO2, PLO7
	CO2 Students are able to explain the models of distributed systems, coordination model, time and event model, communication group model, consistency data and state model, failure model and security model	PLO2, PLO7

	CO3 Students are able to explain, design distributed systems model to implement optional case study, replica, consensus, consistency into application	PLO2, PLO7
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 its 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)	
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	Coulouris, G., Dollimore, J., Kindberg, T., Blair, G., “Distributed Systems: Concepts and Design 5th Edition”, Addison-Wesley, 2011	

Module name	**Digital Forensic**	
Module level	Undergraduate	
Code	IF184945	
Courses (if applicable)	**Digital Forensic**	
Semester	8	
Lecturer	Hudan Studiawan, S.Kom., M.Kom (PIC) Ary Mazharuddin Shiddiqi, S.Kom., M.Comp.Sc., Ph.D.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	Digital Forensics explains various forensic methods in file, operating system, web, computer networks, and on mobile devices as well as anti-forensic technique.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to apply forensic methods to file environments, operating systems, web, computer networks, and on mobile devices and are familiar with anti-forensic techniques.	PLO 2
Content	1. The basic principles and methodologies of digital forensics 2. Introduction, search, and seizure of digital evidence 3. Techniques of data preservation 4. Forensic on operating system 5. Forensics on file	

	6. Forensics on the web 7. Forensic computer network 8. Forensics on mobile devices 9. Investigation of attacks on computer networks network · Anti-forensic techniques
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Nelson, B., "Guide to Computer Forensics and Investigations", Cengage Learning, 2009 Casey, E., "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", Academic Press, 2011 Casey, E., "Handbook of Digital Forensics and Investigation", Academic Press, 2009 Sammons, J., "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics", Elsevier, 2012 Altheide, C., Carvey, H., "Digital Forensic with Open-Source Tools", Elsevier, 2011 Hoog, A., "Android Forensics: Investigation, Analysis and Mobile Security for Google Android", Elsevier, 2011 Daniel, L., Daniel, L., "Digital Forensics for Legal Professionals Understanding Digital Evidence From The Warrant To The Courtroom", Elsevier, 2011

Module name	**Grid and Parallel Computing**	
Module level	Undergraduate	
Code	IF184946	
Courses (if applicable)	**Grid and Parallel Computing**	
Semester	8	
Lecturer	Ir. F.X. Arunanto, M.Sc. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 240 minutes (3 hours) per week. 3. Private study: 3 x 60 = 240 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer networks	
Course description	Parallel computing operates in principle that a large problem can be solved quickly by breaking and processing it in parallel / simultaneously. The increase in resource will make the pace of work is much more improved. This course discusses the concept of parallel computing architecture to solve problems using a parallel approach by using software and technology.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand and explain the concepts of grid and parallel computing.	PLO5, PLO7, PLO9
	CO2 Students are able to analyze and design detail specification requirement to build grid computing infrastructure.	PLO5, PLO7, PLO9

	CO3 Students are able to design parallel algorithm and implementation in parallel programming.	PLO5, PLO7, PLO9
Content	1. Concepts and Terminology, von Neumann Computer Architecture, Shared Memory, Distributed Memory, Hybrid Distributed-shared memory, Programming Model and Communication, Design of Parallel Programs, Partitioning, Synchronization, Load Balancing. 2. Programming on Multicore Architecture. Grid Portal Development, Scheduler & Grid Integration Middleware, Open Grid Services Architecture (OGSA).	
Media employed	LCD, whiteboard, websites, books (as references), etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	Ian Foster and Carl Kesselman, The Grid: Blueprint for a New Computing Infrastructure, 2nd edition, Morgan Kaufmann Publishers, San Francisco, USA (2004), ISBN: 1-55860-933-4. Vladimir Silva, Grid Computing for Developers, 1st edition, Charles River Media Inc., Massachusets, USA (2006), ISBN: 1-58450-424-2. Tao Yang, Lecture Notes on Parallel Scientific Computing, Department of Computer Science University of California Santa Barbara, CA 93106 Barry Wilkinson and Michael Allen, Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, 2nd edition, Prentice Hall CUDA by Example: An Introduction to General-Purpose GPU	

	Programming, 9780131387683 (0131387685), Addison Wesley, 2010

Module name	**Pervasive Computing and Sensor Network**	
Module level	Undergraduate	
Code	IF184947	
Courses (if applicable)	**Pervasive Computing and Sensor Network**	
Semester	8	
Lecturer	Dr.Eng. Radityo Anggoro, S.Kom., M.Sc. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Networks	
Course description	This subject discusses about the concept of pervasive computing, and the aspects that can be supported by the concept. This subject also discusses about how to use techniques to support the implementation of pervasive computing such as smart devices, context-aware system and its interaction with humans.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to understand and implement wireless sensor network and its device	PLO2, PLO9
	CO2 Able to understand the communication methods in wireless sensor network	PLO2, PLO7, PLO9
	CO1 Able to implement communication methods in wireless sensor networks	PLO7, PLO9

Content	1. Ubiquitous Computing: Basics and Vision, Modelling the Key Ubiquitous Computing, Ubiquitous System Environment Interaction, Architectural Design for UbiCom Systems: Smart DEI Model; 2. Smart Devices and Services: Service Architecture Models, Service Provision Life Cycle, Virtual Machines and Operating Systems; 3. Human–Computer Interaction: User Interfaces and Interaction for Four Widely Used Devices, Hidden UI Via Basic Smart Devices; 4. Tagging, Sensing and Controlling: Tagging the Physical World, Sensors and Sensor Networks, Micro Actuation and Sensing: MEMS, Embedded Systems and Real Time Systems, Control System and Robots; 5. Context-Aware Systems: Modelling Context Aware Systems, Mobility Awareness, Spatial Awareness, Temporal Awareness: Coordinating and Scheduling, ICT System Awareness; 6. Intelligent Systems (IS): Basic Concepts, IS Architectures, Semantic Knowledge IS, Classical Logic IS, Soft Computing IS Models, IS System Operations. 7. Ubiquitous Communication: Audio Networks, Data Networks, Wireless Data Networks. 8. Management of Smart Devices: Managing Smart Devices in Virtual Environments, Managing Smart Devices in Human User Centred Environments, Managing Smart Devices in Physical Environments
Media employed	LCD, whiteboard, websites, books (as references), online meetings, etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.

Reading List	• Stefan Poslad, Ubiquitous Computing Smart Devices, Environments, and Interaction, JohnWiley&Sons, Ltd., 2009 • Frank Adelstein, Sandeep K. S. Gupta, Golden G. Richard III, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, McGraw- Hill, 2005

Module name	**Data Compression**	
Module level	Undergraduate	
Code	IF184948	
Courses (if applicable)	**Data Compression**	
Semester	7	
Lecturer	Hudan Studiawan, S.Kom., M.Kom., Ph.D (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, projects	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computer Network	
Course description	In this course, students learn the various methods of compression with statistical approaches, dictionary, and its preprocess on text data, image, audio, and video.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to implement various methods of data compression techniques including statistical-based and dictionary-based techniques on textual data, image, audio and video	PLO 2, PLO 9

Content	1. Introduction to basic compression techniques 2. Introduction to basic theory of information: self-information, entropy, and code efficiency 3. Loosy compression techniques and loosless 4. Compression techniques with statistical approaches: Huffman, Adaptive Huffman, and arithmetic 5. Dictionary-based compression techniques: LZ77, LZ78, and LZW 6. Pre-processing technique for compression: MTF and BWT 7. Techniques of digital image compression: JPEG and CALIC 8. Audio compression technique: MPEG 9. Video compression technique: ITU-T H.261
Media employed	LCD, whiteboard, websites, books (as references), etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Study and examination requirements and forms of examination	Mid-term examination and Final examination. Students must have a final grade of 55.6% or higher to pass.
Reading List	Sayood, K., “Introduction to Data Compression 4th Edition”, Morgan Kauffman, San Fransisco, 2012 Pu, I.M., “Fundamental Data Compression 1st Edition”, Butterworth-Heinemann, Burlington, 2006 Salomon, D., Motta, G., “Handbook of Data Compression 5th Edition”, Springer, London, 2010

Module name	**Data Mining**	
Module level	Undergraduate	
Code	IF184951	
Courses (if applicable)	**Data Mining**	
Semester	6	
Lecturer	Dini Adni Navastara, S.Kom., M.Sc. (PIC) Dr. Eng. Chastine Fatichah, S.Kom., M.Kom. Prof. Dr. Agus Zainal Arifin, S.Kom., M.Kom.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Artificial Intelligence	
Course description	Students will learn about data mining and data analysis in big scale data using various data mining algorithms.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to know about various data types and data sources (database, warehouse, transaction, WWW)	PLO1, PLO6
	CO2 Able to understand the concepts and implement the data preprocessing techniques	PLO1, PLO6
	CO3 Able to develop system for data mining and analyze data pattern by using computational intelligence and probabilistic methods	PLO1, PLO5, PLO9
	CO4 Able to analyze and solve the problems in a case study by using data mining system	PLO1, PLO5, PLO 9

Content	• Introduction of Data Mining: Data Source, Tata type and Attribute Type. • Proximity dan Pre-Processing • Association Rule Process • Classification Process • Clustering Process • Outlier Detection
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, “Introduction to Data Mining”, Addison-Wesley, 2005. Han, Jiawei; Kamber, Micheline, “DATA MINING: CONCEPT AND TECHNIQUES”, Morgan Kauffman Pub, 2001 Rajaraman, Anand, “Mining of Massive Datasets”, Stanford University, 2011

Module name	**Digital Image Processing**	
Module level	Undergraduate	
Code	IF184952	
Courses (if applicable)	**Digital Image Processing**	
Semester	6	
Lecturer	Prof. Ir. Handayani Tjandrasa, M.Sc., Ph.D. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computational Intelligence	
Course description	In this course students learn about the concepts of visual perception, graylevel and color images and binary images, image enhancement and restoration, discrete Fourier, Hough transform, zooming. Furthermore, students learn the process of segmentation, feature extraction methods as image descriptors, methods of morphology, template matching. Students implement techniques learned in the project tasks, both individually and in groups.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to apply digital image processing for visualization, image enhancement, spatial and frequency domain filtering, image improvement using the morphological method, and analyze the results, both with individual performance and in teamwork.	PLO1, PLO7 PLO9
	CO2 Students are able to apply the discontinuity and similarity-based image segmentation method as well as the	PLO1, PLO7 PLO9

	morphological method, and analyze the results, both with individual performance and in teamwork.	
	CO3 Students are able to explain, identify, design, and apply various algorithms for image preprocessing, segmentation, and feature extraction as well as machine learning to produce simple intelligent image processing system models and learn convolutional neural networks (CNN) to recognize image patterns.	PLO1, PLO7 PLO9
	CO4 Students are able to understand and explain the use of image processing system applications	PLO1, PLO9

Content	- Image Enhancement in Spatial Domain:
	  - Curve Transformation,
	  - Histogram,
	  - Histogram Equalization,
	  - Convolution,
	  - Median Filter.
	- Image Transformation:
	  - Fourier Transform,
	  - Hough Transform.
	- Image Enhancement in Frequency Domain:
	  - Ideal LPF,
	  - Butterworth LPF,
	  - Gaussian LPF (GLPF),
	  - IHPF,
	  - BHPF,
	  - GHPF.
	- Colour Images:
	  - Basics of Colour,
	  - Colour Image Processing, and
	  - Pseudo Colour.
	- Image Restoration, Warping, Zooming:
	  - Inverse Filter,
	  - Wiener Filter,
	  - Registration,
	  - Warping,
	  - Zooming.
	- Segmentation:
	  - Line/Edge Detection,
	  - Thresholding,
	  - Region Based Segmentation.
	- Representation and Description:	

	- Chain Codes, - Polygon Approach, - Signature, - Boundary Segmentation, - Skeletoning, - Thinning. - Descriptor: - Boundary Descriptor, - Fourier Descriptor, - Topological Descriptor, - Moment, - Texture, - Correlation - Morphological Methods: - Binary Image, - Connectivity, - Dilation, - Erosion, - Morphological Reconstruction, - Template Matching, - Boundary Extraction, - Thinning.
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.

Reading List	Gonzales, R.C., and Woods, R. E., “Digital Image Processing", 4th ed., Pearson Education, Inc, 2018 Pratt, W.K., “Digital Image Processing”, John Wiley & Sons, Inc., 2007 Forsyth, David A., and Ponce, Jean, “Computer Vision: A Modern Approach”, 2nd Ed., Pearson Education, Inc.,2012 Petrou, Maria, and Petrou, Costas, “Image Processing: The Fundamentals”, John Wiley & Sons Ltd, 2010 Costaridou, Lena (Ed.), “Medical Image Analysis Methods”, Taylor & Francis Group, 2005 Russ, John C., “The Image Processing Handbook”, fifth edition, CRC Press, 2007

Module name	**Biomedical Computing**	
Module level	Undergraduate	
Code	IF184953	
Courses (if applicable)	**Biomedical Computing**	
Semester	7	
Lecturer	Prof. Ir. Handayani Tjandrasa, M.Sc., Ph.D. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computational Intelligence	
Course description	In this course, students will learn computation applied on biomedical areas. Students also will learn about various kinds of format and characteristics of biomedical data such as: clinical lab data, signal data (ECG, EEG), medical image data (X-Ray, MRI, USG, Patology) and gene data (DNA, Microarray, protein). Those data will be analysed and modeled using statistical methods and machine learning methods to solve biomedical problems.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand and explain biosignal data such as electrocardiogram (ECG) and electroencephalogram (EEG), medical image data such as X-ray, Computed Tomography (CT) scan, Magnetic Resonance Imaging (MRI), and Ultrasound (USG), as well as gene data.	PLO1, PLO9

	CO2 Students are able to explain, identify, design, and apply various algorithms to preprocess medical data such as biosignal data, medical image data, and gene data, as well as machine learning to generate simple intelligent biomedical system models.	PLO1, PLO7, PLO9
	CO3 Students are able to understand and explain the use of intelligent biomedical system applications.	PLO1, PLO9
Content	• Introduction to Biomedic • Biomedical Data Description (Numeric Data, Signal Data, Image Data, Gene Data) • Analysis and Modelling of Biomedical Data using Probabilistic • Classification, Clustering and Regression Method	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	
Reading List	Biomedical Informatics, Edward C. Shortlife & James J. Cimino	

Module name	**Robotics**	
Module level	Undergraduate	
Code	IF184954	
Courses (if applicable)	**Robotics**	
Semester	8	
Lecturer	Dini Adni Navastara, S.Kom., M.Sc. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computational Intelligence	
Course description	In this course, students will learn about concepts of robot, kinds of robot, components of robot and how to works, learn how to build and program the robot, understand the types of robot movement and how to apply them, use and apply the various robot sensors, and apply the methods of intelligent system on robot application to solve many challenges.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students understand the concept, various robots, robot components and how they work.	PLO1, PLO9
	CO2 Students are able to assemble robots and to understand robot programming.	PLO1, PLO9
	CO3 Students understand the types of robot movements and how to apply them.	PLO1, PLO9
	CO4 Students are able to utilize and apply various robot sensors.	PLO1, PLO9
	CO5 Students are able to apply intelligent system methods to robots	PLO1, PLO9

Content	• Introduction to Robot, Kinds of Robot, Components of Robot and How it Works. • How to Build Robot. • Introduction to Robot Programming Language (use RobotC). • Types of Robot Movement and How to Apply Them. • Various Robot Sensors (Light Sensor, Sound Sensor, Touch Sensor, etc).
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	John C. Hansen, LEGO Mindstorms NXT Power Programming: Robotics in C, second edition, Variant Press, 2009 Kim, Yong-Tae, Kobayashi, Ichiro, Kim, Euntai, Soft Computing in Advanced Robotics, Springer Robin R. Murphy, Introduction to AI Robotics, The MIT Press, 2000

Module name	**Information Retrieval**	
Module level	Undergraduate	
Code	IF184955	
Courses (if applicable)	**Information Retrieval**	
Semester	7	
Lecturer	Dr. Diana Purwitasari, S.Kom., M.Sc. (PIC)	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computational Intelligence	
Course description	Students will learn text data processing techniques to retrieve information on text-formed data. Discussion subjects includes preprocessing, feature extraction, calculation of text similarity level based on query input, and show the seearching results. Then, relevance feedback technique, text classification and clustering to help user on search. Students will design, analyse and apply information retrieval methods on various real problems either individually or team work.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Understanding concepts in various models of text based-information retrieval (IR) systems and their applications	PLO1

	CO2 Able to implement IR techniques for indexing, searching, query processing to obtain the information need	PLO1, PLO6
	CO3 Able to implement IR techniques for information extraction (i.e. classification or clustering) and visualize the results according to the information need	PLO6, PLO8, PLO9
	CO3 Able to appropriately solve some simple or controlled IR problems , such as text summarization, recommendation system, or latent semantic analysis, etc.	PLO6, PLO8, PLO9
Content	• Retrieval Model with: - Boolean, - Vector Space, - Probabilistic, - Library Lucene, - Performance Evaluation, - Relevance Feedback, - Web Search, - Classification and Clustering. • Applications: - Image-Based Retrieval, - Latent Semantic Indexing, - Recommendation System, - Information Extraction.	
Study and examination requirements and forms of examination	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	• Ricardo Baeza-Yates, Berthier Ribeiro-Neto, “Modern Information Retrieval: The Concepts and Technology behind Search 2nd Ed”, Addison-Wesley, New Jersey, 2011 • Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, “Introduction to Information Retrieval”, Cambridge University Press, 2008

Module name	**Computer Vision**	
Module level	Undergraduate	
Code	IF184956	
Courses (if applicable)	**Computer Vision**	
Semester	7	
Lecturer	Dr.Eng. Nanik Suciati, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Course Description	Computer vision aims to automatically compute information and decide from an observed image, image set or an image sequence. It combines concepts from 'image processing' and 'computational intelligence'. Computer vision has many various potential applications, including medical applications, surveillance (e.g. face recognition), industrial inspection, satellite imaging, etc. This unit covers topics such as feature extraction, image segmentation and recognition. It also covers camera calibration and projective geometry and how three-dimensional information can be reconstructed from single images, stereo pairs of images and motion sequences.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to explain the concept of computer vision and its application in various fields.	PLO1, PLO9

	CO2 Students are able to explain conventional methods of image recognition which consist of several processes, namely pre-processing (image filtering for sharpening/blurring/edge detection), feature extraction (Local Binary Pattern, Wavelet, Histogram of Oriented Gradient, BRISK, etc.) and classification.	PLO1, PLO8, PLO9
	CO3 Students are able to explain deep learning methods with Convolutional Neural Networks for image recognition, detection and segmentation, including various existing deep learning architectures for recognition (AlexNet, VGG, ResNet, etc.), object detection (FastRCNN, Yolo, SSD), and object segmentation (Mask-RCNN, Poly-YOLO).	PLO1, PLO8, PLO9
	CO4 Students are able to develop image recognition programs using deep learning and are able to analyze the performance of the program.	PLO1, PLO8, PLO9
	CO5 Students are able to develop object detection programs in images using deep learning and are able to analyze the performance of the program.	PLO1, PLO8, PLO9

Content	• Introduction:
	  • Image Formation,
	  • Camera Models,
	  • Perspective Geometry,
	  • Overview of Current State-of-art computer Vision systems.
	• Review of Digital Image Processing Unit:
	  • Binary Image Analysis,
	  • Fourier Transform,
	  • Grayscale Image Analysis.
	• Recognition and Classification:
	  • Feature Extraction,
	  • Edge Detection.
	• 3D Reconstruction:
	  • Camera Calibration,
	  • Projective Geometry,
	  • Stereo,
	  • Epipolar Geometry,
	  • Structured Light Systems.
	• Optical Flow and Tracking.
	• 3D Shape Analysis and Matching.	

Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer-Verlag, London, 2011. David A. Forsyth dan Jean Ponce, "Computer Vision: A Modern Approach, 2nd Edition", Prentice Hall, 2012. Christian Wöhler, "3D Computer Vision: Efficient Methods and Applications", Springer-Verlag, Berlin Heidelberg, 2009. Francisco Escolano, Pablo Suau, Boyán Bonev, "Information Theory in Computer Vision and Pattern Recognition", Springer Verlag, London, 2009.

Module name	**Social Network Analysis**	
Module level	Undergraduate	
Code	IF184957	
Courses (if applicable)	**Social Network Analysis**	
Semester	8	
Lecturer	Dr. Diana Purwitasari, S.Kom., M.Sc. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computational Intelligence	
Course description	Students will learn about data analysis techniques on social media (twitter, facebook, blog, etc) to obtain information related to user's behaviors and habits of community on the real world. Analysis outputs are quantitative and qualitative outputs including discussion topic extraction, user's mood and sentiment recognition (positive/negative), measurement of the effectiveness evaluation in social media program, relationship between users in community, exploration result on graph/table/curve etc. Analysis output information can be used as a feed back or consideration of policy making/decision support.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Collect network data and input it into social network analysis packages, Transform data for analysis using graph-	PLO1, PLO6

	based and statistics-based social network measures, then Visualize network data using different methods and packages	
	CO2 Design a research study on interactions between individuals and actors	PLO1, PLO6
	CO3 Apply the basics of social network analysis at the network level (e.g. density, clustering, degree distribution, etc.); at the node level (e.g. degree, betweenness, closeness); at the subgraph level (e.g. triads, communities)	PLO1, PLO6
	CO4 Students are able to design and implement social network analysis on a real problem independently or in teamwork Able to appropriately solve some simple or controlled social network analysis problems	PLO6, PLO8, PLO9

Content	• Introduction to Social Network Analysis with Networking Type Concept Based on Graph Theory:
	  • Full, Partial, or Egocentric Network
	  • Unimodal, Multimodal, or Affiliation Network
	  • Multiplex Network
	• Network Analysis Measures for Measuring Community Users:
	  • Aggregate
	  • Vertex-specific (Degree, Closeness, Betweenness, Eigenvector)
	  • Important Position Analysis (Centrality, Prestige)
	  • Relationship Analysis (Structural Balance, Transitivity)
	  • Social Group Analysis (Cohesive Subgroups)
	  • Role and Position Analysis (Structural Equivalence)
	• Community Detection and Evaluation:
	  • Node-Centric,
	  • Group-Centric,
	  • Network-Centric,
	  • Hierarchy-Centric.
	• Study Case on Social Media Network Analysis (e-Mail, Threaded Conversation, Twitter, Facebook, World Wide Web (WWW), Flickr, YouTube, Wikis).
	• Application Examples:
	  • Pattern Change in Social Media,
	  • Classification of Social Network,
	  • Recommendation and Community Behaviour Analysis.	

	• Implementation steps of social media analysis, starting from collect data to visualization of analysis output individually or teamwork with/out open-source library.
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.
Reading List	Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining: An Introduction", Cambridge University Press, 2014 Matthew A. Russell, "Mining the Social Web 2nded.", O'Reilly, 2014 Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups", O'Reilly, 2011

Module name	**Deep Learning**	
Module level	Undergraduate	
Code	IF184958	
Courses (if applicable)	**Deep Learning**	
Semester	8	
Lecturer	Dr.Eng. Chastine Fatichah, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; compulsory. 2. International undergraduate program; compulsory.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Computational Intelligence	
Course description	In this course students learn the theories, principles and techniques of deep learning and apply it to solve real world problems that include learning single mode, multiple modes, and generative models. Students also learn the various application of deep learning such as image classification, generate information on image / video / voice data, language translation, and generate models for simulation / planning purposes.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to explain the theory and principles of the Deep Sequence model and use the model to solve appropriate problems	PLO1
	CO2 Students are able to explain the theory and principles of Convolutional Neural Network emergent structures and their variations and use the model to solve appropriate problems.	PLO1

	CO3 Students are able to explain the theory and principles of the Deep Generative model and use the model to solve appropriate problems	PLO1
	CO4 Students are able to explain the theory and principles of Deep Reinforcement Learning and use the model to solve appropriate problems	PLO1
	C05 Students are able to apply appropriate deep learning architectures to solve real problems	PLO1, PLO6, PLO9
Content	• Introduction of Deep Learning, Perceptron, Multi-Layer Perceptron, and Algorithm Training. • Sequence Modelling with Neural Networks: - Recurrent Neural Networks, - Application in Machine Translation, - Training RNN. • Deep Learning for Computer Vision: - Image Classification Pipeline, - Convolutional Neural Network, - Object Recognition, - Some Applications: Image Caption Generation, Video Description Generation, Image Question Answering. • Deep Generative Models: learning to understand data (image, audio, handwritten, language) through generation and compression as implicit generative modelling. • Multimodal Learning: - Flickr (joint learning of images and tags) - SoundNet (learning sound representation from videos) - Image captioning (generating sentences from images)	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	

Reading List	Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press Book, 2017.

Module name	**Enterprise System**
Module level	Undergraduate
Code	IF184961
Courses (if applicable)	**Enterprise System**
Semester	7
Lecturer	Prof. Drs.Ec. Ir. Riyanarto Sarno, M.Sc., Ph.D. (PIC) Ary Mazharuddin Shiddiqi, S.Kom., M.Comp.Sc., Ph.D.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching methods	Lecture, lab works, project
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 240 minutes (3 hours) per week. 3. Private study: 3 x 60 = 240 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Database System
Course description	In this course students learn business processes and enterprise information systems. Students are expected to achieve competence in analysis, design and implement enterprise systems related to the business processes. Several systems are discussed, such as financial accounting, management accounting and cost accounting. Customer Relationship Management (CRM), Supplier Relationship Management (SRM), and Enterprise Resource Planning (ERP) are also discussed.
	After completing this module, a student is expected to:

Learning outcomes and their corresponding PLOs	**CO1** Students are able to explain business processes and information systems in enterprise systems	PLO9, PLO10
	CO2 Students are able to analyze and evaluate business process models	PLO9, PLO10
	CO3 Students are able to design and analyze business process models	PLO9, PLO10
	CO4 Students are able to detect deviations and optimize business process models	PLO9, PLO10
Content	1. Architectures of enterprise information, architectures of enterprise applications, business process management, business process modeling, business process composition. Service oriented architecture (SOA), web services and enterprise service bus (ESB)	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Simha R. Magal, Integrated Business Processes with ERP Systems, John Wiley & Sons, Inc., 2012 • Riyanarto Sarno, ANALISIS DAN DESAIN BERORIENTASI SERVIS UNTUK APLIKASI MANAJEMEN PROYEK, Andi Publisher, 2012, ISBN 978-979-29-3072-6. • Manfred Reichert, Barbara We, Enabling Flexibility in Process-Aware Information Systems, Challenges, Methods, Technologies. SpringerVerlag, Berlin Heidelberg, 2012. • Riyanarto Sarno, STRATEGI SUKSES BISNIS DENGAN TI Berbasis Balanced Scorecard dan COBIT, ITS Press, 2009, ISBN 978-979-8897-42-9. • Riyanarto Sarno, et al. (2013). Petri Net Model of ERP Business Process Variations for Small and Medium Enterprises, Journal of	

	Theoretical and Applied Information Technology, 10th August 2013. Vol. 54 No.1, pp.31-38. • Riyanarto Sarno, Yeni Anistyasari dan Rahimi Fitri, SEMANTIC SEARCH, Andi Publisher, 2012, ISBN 978-979-29-3110-5.

Module name	**Knowledge Engineering**	
Module level	Undergraduate	
Code	IF184962	
Courses (if applicable)	**Knowledge Engineering**	
Semester	7	
Lecturer	Nurul Fajrin Ariyani, S.Kom., M.Sc. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Database System	
Course description	In this subject, student will learn about the concept of tacit knowledge and knowledge engineering techniques related to elicite, model, distribute, and use the knowledge effectively. At the end of the course, students should be able to implement knowledge engineering into application either independently and cooperatively.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	PLO6
	CO1 Students can explain the concept of tacit knowledge and its heterogeneous format in the real world.	PLO6
	CO2 Students can identify the elements within knowledge engineering concepts in a real case study.	PLO6, PLO7

	CO3 Students can represent the knowledge in a conceptual model using tools.	PLO6, PLO7
	CO4 Students can design and implement rules in a conceptual model and logically justify the inference results.	PLO6, PLO7
	CO5 Students can implement knowledge engineering into an application.	PLO6, PLO7, PLO9
Content	• Introduction to Knowledge Engineering: data, information and knowledge, knowledge elicitation techniques, knowledge modelling techniques. • Knowledge Acquisition: knowledge acquisition definition, techniques and methods in knowledge acquisition • Knowledge Validation: definition, parameters, and validation measurement processes, technique and method to validate knowledge • Knowledge Representation: definition, knowledge engineering process, techniques in knowledge engineering • Inference, Explanation and Justification • Semantic Web: semantic web roadmap, ontology and knowledge representation on semantic web, semantic web education, layer cake, XML, RDF/S • Knowledge engineering application to solve the actual problems	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Simon Kendal and Malcolm Creen, an Introduction to Knowledge Engineering, Springer, 2006. • R.J. Brachman and H.J. Levesque, Knowledge Representation and Reasoning, Elsevier, 2004.	

	• Segaran, Evans, and Taylor, Programming the Semantic Web, O'Reilly, 2009.

Module name	**Systems Audit**	
Module level	Undergraduate	
Code	IF184963	
Courses (if applicable)	**Systems Audit**	
Semester	7	
Lecturer	Kelly Rossa Sungkono, S.Kom., M.Kom. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching methods	Lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Database System	
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.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the purpose of an information technology audit and identify process and information risks related to confidentiality, integrity and availability	PLO6, PLO9, PLO10

	CO2 Students are able to design and carry out audit processes that are suitable for enterprise needs	PLO6, PLO9, PLO10
	CO3 Students are able to design and implement procedures and control measures to manage risk effectively	PLO6, PLO9, PLO10
	CO4 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, PLO9, PLO10
Content	1. 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	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Riyanarto Sarno, Audit Sistem Informasi/Teknologi Informasi, ITS Press, 2009. • Riyanarto Sarno, Strategi Sukses Bisnis dengan Teknologi Informasi Berbasis Balanced Scorecard dan COBIT, ITS Press, 2009, ISBN 978- 979-8897-42-9. • Simha R. Magal, Integrated Business Processes with ERP Systems, John Wiley & Sons, Inc., 2012 • Riyanarto Sarno & Irsyat Iffano, Sistem Manajemen Keamanan Informasi, ITS Press, 2009	

Module name	**Information Technology Governance**	
Module level	Undergraduate	
Code	IF184964	
Courses (if applicable)	**Information Technology Governance**	
Semester	8	
Lecturer	Adhatus Solichah Ahmadiyah, S.Kom., M.Sc. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Database Management, Analysis and Planning of Information Systems	
Course description	In this course, students learn basic principles of Information Technology Governance. This course will discuss the importance of IT governance and IT governance framework, including project, human resource and infrastructure governance.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the importance of IT governance	PLO6
	CO2 Students are able to use IT governance frameworks	PLO6

	CO3 Students are able to explain project and human resource governance	PLO7
	CO4 Students are able to explain infrastructure governance	PLO7
Content	1. Business Process Management, Risk Management, IT Governance Framework (COBIT & ITIL), Project and Human Resource Governance (Human Resource, Requirement Analysis, Project Management, Change Management), Infrastructure Governance	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	Webber, L. and Wallace, M., IT Governance: Policies and Procedures 2014 Edition, Wolters Kluwer, 201	

Module name	**Distributed Databases**	
Module level	Undergraduate	
Code	IF184965	
Courses (if applicable)	**Distributed Databases**	
Semester	7	
Lecturer	Abdul Munif, S.Kom., M.Sc.Eng. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Database Management	
Course description	In this course student will learn the principal of distributed database. The topics that will be discussed are distributed database concept, distributed database architecture, query optimization, data replication, and current issues in distributed database.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students understand the design of distributed database architecture	PLO6, PLO8, PLO9, PLO10
	CO2 Students understand important issues in distributed databases (data and access control,	PLO6, PLO8,

	concurrency, deadlocks, data replication, and transaction management) and their solutions.	PLO9, PLO10
	CO3 Students understand and are able to apply optimization in distributed databases (optimization of queries, parallel queries, decomposition and localization of data)	PLO6, PLO8, PLO9, PLO10
	CO4 Students are able to design and implement distributed database solutions for real cases	PLO6, PLO8, PLO9, PLO10
Content	1. Distributed Database Design 2. Data Control and Access 3. Concurrency Control 4. Query Optimization (Query Processing, Parallel Query, Data Decomposition and Localization) 5. Deadlock Handling 6. Data Replication Technique 7. Transaction Management (Failure and Commit Protocols) 8. Parallel Database System 9. Distributed Database Object Management	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• M. T. Özsu and P. Valduriez, Principles of Distributed Database Systems, London: Springer, 2011. • S. K. Rahimi and F. S. Haug, Distributed Database Management Systems: A Practical Approach, Hoboken, New Jersey: John Wiley & Sons, Inc., 2010	

Module name	**Big Data**	
Module level	Undergraduate	
Code	IF184966	
Courses (if applicable)	**Big Data**	
Semester	8	
Lecturer	Abdul Munif, S.Kom., M.Sc.Eng. (PIC)	
Language	Bahasa Indonesia dan English	
Relation to curriculum	1. Undergraduate degree program; elective. 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Database System	
Course description	In this course students will learn about current issues and aspects in big data. This course focuses on introduction and implementation of big data with large scale, large variety, and high speed access (volume, variety, and velocity). Students also learn about data processing techniques and data mining for big data.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the design and architecture of several large-scale data storage systems (Hadoop, graph based databases, etc.)	PLO6, PLO8, PLO9, PLO10

	CO2 Students understand and are able to apply several data mining methods for large-scale data	PLO6, PLO8, PLO9, PLO10
	CO3 Students are able to apply big data rules in real cases (content recommendation systems, advertisements, and social networks)	PLO6, PLO8, PLO9, PLO10
	CO4 Students understand and are able to apply optimization in large-scale data processing	PLO6, PLO8, PLO9, PLO10
Content	1. Data Mining MapReduce 2. Finding Similar Items (Near-Neighbor Search, Shingling of Documents). 3. Mining Data Streams 4. Link Analysis 5. Frequent Itemsets 6. Clustering 7. Advertising on the Web 8. Recommendation System 9. Mining Social-Network Graphs 10. Dimensionality Reduction	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• J. Leskovec, A. Rajaraman and J. Ullman, "Mining of Massive Datasets," 15 August 2014. [Online]. Available: http://www.mmds.org/ • H. Cuesta, Practical Data Analysis, Birmingham: Packt Publishing Ltd., 2013. • V. Mayer-Schönberger and K. Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, New York: Eamon Dolan/Houghton Mifflin Harcour, 2013.	

	• N. Sawant and H. Shah, Big Data Application Architecture Q&A, A Problem - Solution Approach, New York: Apress, 2013. • P. Giacomelli, Apache Mahout Cookbook, Mumbai: Packt Publishing, 2013. • V. Prajapati, Big Data Analytics with R and Hadoop (Community Experience Distilled), Mumbai: Packt Publishing, 2013.

Module name	**Geographic Information System**	
Module level	Undergraduate	
Code	IF184967	
Courses (if applicable)	**Geographic Information System**	
Semester	7	
Lecturer	Dr.techn. Ir. Raden Venantius Hari Ginardi, M.Sc. (PIC) Adhatus Solichah A., S.Kom., M.Sc.	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; elective 2. International undergraduate program; elective.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	Lecture, lab works, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Object Oriented Programming	
Course description	In this course students will learn about different concept between geographic information systems and another information system. Students will analyze the spatial-temporal data, analysis of 3-D surface, map coordinate system and projection system. In addition, students develop theme map from gps tracking according to the latest approach.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to make digital maps both vector and raster according to the correct coordinate system	PLO6
	CO2 Able to perform spatial analysis of problems related to geospatial data to support decisions	PLO 1, PLO7

	CO3 Able to build location-based services with web-based or mobile applications	PLO1, PLO9
	CO4 Able to build applications related to geospatial using online map or mapserver	PLO9
Content	1. Map Projection and Coordinate System 2. Map digitizing 3. GPS 4. Remote Sensing - Thematic Map 5. Spatial Analysis 6. 3-D Analysis 7. Community-Based Mapping 8. Location-based Services	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments.	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments : 15% • Written Midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	
Reading List	• Longley, P.A., Goodchild, M.F., Maguire, D.J., and Rhind, D.W., 2011, Geographic Information Systems and Science, New York, John Wiley & Sons. • Narayan Panigrahi, Computing in Geographic Information System, CRC Press, 2014 • Quantum GIS, online resources (www.qgis.org) • OpenStreetMap, online resources • Google Map API, online resources	

Module name	**Software Architecture**
Module level	Undergraduate
Code	IF184971
Courses (if applicable)	**Software Architecture**
Semester	6 (Genap)
Lecturer	Rizky Januar Akbar, S.Kom., M.Eng. (PIC)
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; optional; 6^{th} or 8^{th} semester. 2. International undergraduate program; optional; 6^{th} or 8^{th} semester.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, project
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Analysis and Design of Information Systems
Course description	In this course, students design structures for software system according to requirement specification or given case studies. Disciplines in this course are determining high-level structures and dividing them into components, their dependencies and connectivities based on the software system characteristics. In developing the software architectural design, students can utilize design patterns that are available. Students also need to document their architectural design and use it as a communication tool among developers and other stakeholders.
	After completing this module, a student is expected to:

<table>
<tr><td rowspan="4">Learning outcomes and their corresponding PLOs</td><td>CO1 Able to think architecturally</td><td>PLO3</td></tr>
<tr><td>CO2 Able to analyze and to make architectural decision based on domain problem</td><td>PLO3</td></tr>
<tr><td>CO3 Able to adopt a software architectural style that is suitable with the software requirements and characteristics</td><td>PLO3</td></tr>
<tr><td>CO4 Able to explain and to communicate software architecture to the stakeholders</td><td>PLO3, PLO9</td></tr>
<tr><td>Content</td><td colspan="2">1. Types of software.
2. Types of software architecture (monolithic, client-server, two-tier, threetier, modelview-controller, etc).
3. Principles of software architecture design.
4. Layering concept and component dependencies.
5. Diagram notations on software architecture.
6. Software architecture viewpoints (logical view, process view, development view, and physical view).
7. Design patterns (creational patterns, structural patterns, dan behavioral patterns).
8. Enterprise application architecture, networked application architecture (optional)
9. The issue of research in distributed systems (load balancing, load estimation, load migration, and big data)</td></tr>
<tr><td>Media employed</td><td colspan="2">LCD, whiteboard, websites, books (as references), online meeting, etc.</td></tr>
<tr><td>Assessments and Evaluation</td><td colspan="2">One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td colspan="2">The final grade in the module is composed of:
• Two short computer-based quizzes: 15% x 2 = 30%
• Take-home written assignments: 15%
• Written midterm assessment: 25%
• Final oral exam: 30%

Students must have a final grade of 55.6% or higher to pass.</td></tr>
</table>

Reading List	Gamma, Erich. Design Patterns: Elements of Reusable Object-oriented Software. Reading, Mass.: Addison-Wesley, 1995 Fowler, Martin. Patterns of Enterprise Application Architecture. Boston: Addison-Wesley, 2003

Module name	**Software Quality Assurance**	
Module level	Undergraduate	
Code	IF184972	
Courses (if applicable)	**Software Quality Assurance**	
Semester	8	
Lecturer	Ir. Siti Rochimah, M.T.,Ph.D.(PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; optional; 8th semester. 2. International undergraduate program; optional; 8th semester.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	-	
Course description	The purpose of this course is to provide knowledge to the students about the basic concepts and techniques of recent testing software. It also gives other important aspects related to software quality including: aspects of documentation, security, fault tolerance, reliability assessment, and so on. In some discussion, a case study is also given to allow students to apply the theories, concepts, and techniques into the given case.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Students are able to understand the basics of software testing.	PLO3, PLO6

	CO2 Students are able to explain in detail: (1) types, levels, and methods/techniques of testing; (2) testing metrics; (3) testing artifacts; and (4) types of software defect.	PLO3, PLO6
	CO3 Students are able to apply the process of testing and measuring software quality, using testing tools, through case studies of small/medium scale applications.	PLO3, PLO6, PLO8, PLO9
	CO4 Students are able to analyze the test results of the case study application, and evaluate the causes of the defects and provide recommendations for improvement, on the application being tested.	PLO3, PLO6, PLO8, PLO9
Content	1. Basics of software testing: Terminology related to testing,Main issues, Relationship among testing and other activities 2. Testing level: Testing targets, Testing objectives 3. Testing techniques: Based on the software engineer's intuition and experience, Input domain-based techniques, Code-based techniques, 4. Fault-based techniques, Usage based techniques, Model-based testing techniques, Techniques based on the nature of the application 5. Test-related measures: Evaluation of the program under test, Evaluation of the tests performed 6. Test Process: Practical considerations, Test activities 7. Software testing tools: Testing tool support, Categories of tools 8. Basics of software quality: Software ethics and culture, Value and cost of software quality, Software quality and model characteristics, Software process improvement, Aspects related to software safety	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	S. Naik and P. Tripathy, Software Testing and Quality Assurance: Theory and Practice, Wiley-Spektrum, 2008. S.H. Kan, Metrics and Models in Software Quality Engineering, 2nd ed., Addison-Wesley, 2002. D. Galin, Software Quality Assurance: From Theory to Implementation, Pearson Education Limited, 2004.

Module name	**Software Evolution**
Module level	Undergraduate
Code	IF184973
Courses (if applicable)	**Software Evolution**
Semester	7
Lecturer	Ir. Siti Rochimah, M.T, Ph.D (PIC)
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program; optional; 7th semester. 2. International undergraduate program; optional; 7th semester.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students
Teaching Methods	lecture, project
Workload	1. Lectures: 3 sks x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Mandatory prerequisites	Analysis and Design of Information Systems
Course description	Students will learn about software as an entity that is constantly evolving and complex. In addition, they are also equipped with common issues related to software maintenance, the importance of software design related to its maintenance efforts, reverse engineering techniques to improve the software interability. In some discussion, a case study is also given to allow students to apply the theories, concepts, and techniques in the case.
	After completing this module, a student is expected to:

Learning outcomes and their corresponding PLOs	**CO1** Students are able to understand the basic concepts and activities of software evolution: evolutionary models and processes; types of software evolution (corrective, adaptive, perfective, and preventive); legacy system, program understanding; software sequence; change impact analysis; software defect; and other basic activities.	PLO3, PLO6
	CO2 Students are able to apply techniques in program understanding activities and carrying out the refactorring process.	PLO3, PLO6
	CO3 Students are able to apply techniques in identifying bad smell codes, clone codes, and are able to use tools in carrying out the process.	PLO3, PLO6, PLO8, PLO9
	CO4 Students are able to apply the process of reengineering and software reuse, and are able to analyze the advantages and disadvantages of the engineering results.	PLO3, PLO6, PLO8, PLO9
Content	1. ROAD MAP AND EMPIRICAL STUDY: history and challenge in software evolution; the similarity and difference between software evolution and software maintenance. 2. LEHMAN's LAW: Lehman's law in software evolution, introduction to S-, P-, and Esystem type. 3. THE ACTIVITIES IN SOFTWARE EVOLUTION: the types of 4. software maintenance such as corrective, adaptive, perfective, and preventive; activities in software interoperability; software changes analysis, tools in software evolution e.g. DDF, CFG, etc. 5. PROGRAM COMPREHENSION: program structure visualization, static code analysis, control dependencies diagram, CFG. 6. CODE CLONING: introduction to cloning; cloning types; cloning sources; cloning evolution, clone detection and management; clone removal techniques, clone algorithm and development. 7. SOFTWARE REPOSITORIES: introduction to software repositories and software repository analysis; releas history. 8. 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. 9. REFACTORING: refactoring techniques, bad smell code removal, the advantages, risks, and refactoring cost. 10. SOFTWARE EVOLUTION TOOLS: tools to predict detect code clone and bad smell code, tools to software repository. 11. SOFTWARE METRICS: the types of software metrics such as LOC, aggregration metric, structure and modular metric of object oriented program, package metric, churn metric, and time and cost estimation metric.
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.
Reading List	Stephan Diehl, Software Visualization: Visualizing the Structure, Behaviour, and Evolution of Software, Springer-Verlag, Berlin, 2007 Nazim H. Madhavji, Juan Fernandez-Ramil, dan Dewayne Perry, Software Evolution and Feedback: Theory and Practice, John Wiley & Sons, England, 2006. J. Fernandez-Ramil et al., Empirical Studies of Open Source Evolution. R. Koschke, Identifying and Removing Software Clones. E. Duala-Ekoko and M.P. Robillard, Tracking Code Clones in Evolving Software, In Proceedings of the 29th International Conference on Software Engineering.

Module name	**Software Construction**	
Module level	Undergraduate	
Code	IF184974	
Courses (if applicable)	**Software Construction**	
Semester	7	
Lecturer	Rizky Januar Akbar, S.Kom., M.Eng. (PIC)	
Language	Bahasa Indonesia and English	
Relation to curriculum	1. Undergraduate degree program; optional; 7th semester. 2. International undergraduate program; optional; 7th semester.	
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 40 students	
Teaching Methods	lecture, project	
Workload	1. Lectures: 3 x 50 = 150 minutes (2 hours 30 minutes) per week. 2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Private study: 3 x 60 = 180 minutes (3 hours) per week.	
Credit points	3 credit points (sks).	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Analysis and Design of Information Systems and Software Design (taken)	
Course description	In this course students deliberately execute steps on the construction phase to produce high-quality software that is easy to maintain (high maintainability). Students perform detailed design, coding and testing in a selected case study. The construction emphasizes on code readability, code maintainability, bugs and error prevention. Students also collaborate with other students as developers and experience software integration.	
Learning outcomes and their corresponding PLOs	After completing this module, a student is expected to:	
	CO1 Able to collaborate in a software development team using version control system (VCS).	PLO3, PLO9

	CO2 Able to apply best practices on writing source code.	PLO3
	CO3 Able to develop software using software design principles.	PLO3
	CO4 Able to write testable source code.	
Content	1. Phases on software construction. 2. Software development metaphors. 3. Prerequisites of software construction. 4. Software construction approach. 5. Creating high-quality code: creating classes, creating procedures or routines. 6. Version control system: workflow using Git (commit, push, pull, and branching). 7. Defensive programming: error handling, assertions, exceptions, and debugging. 8. Coding convention: use of variables and data types, variable naming, code layouting. 9. Statement organization: branch structures, loop structures. 10. Code improvements: unit testing, debugging, and refactoring. 11. Integration: integration approaches, incremental strategy, daily builds, and smoke test. 12. Case study on software construction.	
Media employed	LCD, whiteboard, websites, books (as references), online meeting, etc.	
Assessments and Evaluation	One written Midterm assessment (60 minutes) and one final oral exam (30 minutes), two short computer-based quizzes, take-home written assignments	
Study and examination requirements and forms of examination	The final grade in the module is composed of: • Two short computer-based quizzes: 15% x 2 = 30% • Take-home written assignments: 15% • Written midterm assessment: 25% • Final oral exam: 30% Students must have a final grade of 55.6% or higher to pass.	

Reading List	McConnell, S.Code Complete: A Practical Handbook of Software Construction, 2nd Edition. Redmond, Wash: Microsoft Press, 2004. Fowler, Martin, and Kent Beck. Refactoring: Improving the Design of Existing Code. Reading, MA: Addison-Wesley, 1999. Martin, Robert C., and Micah Martin. Agile Principles, Patterns, and Practices in C♯. Upper Saddle River, NJ: Prentice Hall, 2007. Brooks, Frederick P. The Mythical Man-month Essays on Software Engineering. - Anniversary Ed. Reading, Mass.: Addison-Wesley Pub., 1995. Gamma, Erich. Design Patterns: Elements of Reusable Object-oriented Software. Reading, Mass.: Addison-Wesley, 1995.