STUDY PROGRAM CURRICULUM
UNIVERSITAS MULTIMEDIA NUSANTARA

Drafting Team

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CURRICULUM OF THE INFORMATICS STUDY PROGRAM

A. Profile of Informatics Study Programme

Study materials in Study Programme refers to legal basic, such as :

- Law Number 20 of 2003 Concerning the Higher Education System
- Law Number 12 of 2012 Concerning Higher Education
- Presidential Regulation Number 8 of 2012 Concerning KKNI (Indonesia Education Qualification Framework)

- Minister of National Education Regulation No. 73 of 2013 concerning the Application of the Indonesian National Qualifications Framework for Higher Education
- Regulation of the Minister of Education and Culture No. 3 of 2020 concerning National Higher Education Standards.

Table 1. Study Programme Specification :

Study Program	:	Informatics
Faculty	:	Engineering and Informatics
Establishment Decree Number	:	169/D/O/2005
Operational Permit Decree Number	:	2029/SK/BAN-PT/Akred/S/IX/2016
Date of Decree of Operational Permit	:	29 September 2016
Title Name	:	S.Kom (Sarjana Komputer)
Degree Granting Institution	:	Universitas Multimedia Nusantara
Learning and Teaching Institutions	:	Universitas Multimedia Nusantara
Class	:	Regular and Join Degree (with Swinburne University)
Language of Instruction	:	Bahasa Indonesia and English
Program Duration	:	48 months (4 years)
Number of Credits	:	146 Credits

KKNI Level	:	Level 6
Last Accreditation Rank	:	BAN – PT Akreditasi B (2020-2025)
BAN-PT Decree Number		6574/SK/BAN-PT/Akred/S/X/2020
Quality Assurance benchmarks	:	BAN – PT ASIIN (international accreditation – on going)
Website	:	https://www.umn.ac.id/en/informatics/ and https://inf.umn.ac.id/web/

Program Education Objectives

In Informatics Study Programme, there is Program Education Objectives that have to achieve by students. There are :

1. Produce graduates who are competent in the fields of intelligent systems, software development, computer systems and networks, and use their expertise to build and develop systems based on informatics science
2. Produce graduates who understand the development, engineering and construction of systems in the fields of intelligent systems, software engineering, systems and network security based on professional ethics imposed in informatics science
3. Produce graduates who carry out lifelong learning in the field of informatics science which then continues to be applied when graduates work nationally and internationally, conduct research, community service in order to face the global era of industry 4.0

B. Career Prospect and Opportunities

When graduating from Informatics Study Programme, graduates have the opportunity to work as (based on tracer study 2020-2021) :

- Smart system developer
- Expert system developer
- Computer security analyst

- Mobile – cross platform app developer
- Database developer
- Desktop application programmer
- Web designer
- Web programmer
- Database designer
- Android app developer
- System analyst
- IT Consultant
- IT Support
- Project Manager
- Researcher

C. Graduate Profile Informatics Study Programme

Become an Informatics Specialist in area of :

1. **Technopreneur**- Becoming an individual who is able to create business concepts based on existing opportunities by taking advantage of the development of technology and knowledge in the field of computer science.
2. **Data Scienties**- Become an individual who is able to develop theories or formulas to build conclusions and recommendations from existing data by using calculations and statistical analysis.
3. **Machine Learning Engineer**-Become an individual who is able to create machine learning-based programs to take actions independently and automatically.
4. **Full Stack Developer**-Become an individual who is able to design the layout interface and application architecture, including developing program, testing, monitoring and evaluation, as well as able to work in teams for complex projects.
5. **Software Developer**-Become an individual who is able to develop programs by utilizing concepts

in the field of networks, operating systems, and databases, as well as able to work in teams for complex projects.

6. **Application Security Architech**-Become an individual capable of designing and building security for computer applications, including testing programs for security vulnerabilities, performing vulnerability scans, and providing security guidance to software development teams.
7. **Research Assitant**- Become an individual who is able to conduct scientific research and present it in the form of scientific papers in accordance with applicable rules and ethics.

D. Expected Learning Outcome (ELO)

Table 2. ELO in Informatics Study Program

Code	Keyword	Program Learning Outcome / Expected Learning Outcome
ELO 1	Religiosity and Ethical Intelligence	Have an understanding of ethical and moral rules in studying, working, and society in the field of informatics
ELO 2	Communication Skill	Have the ability to communicate effectively and skillfully
ELO 3	Problem Solving Skill	Have the ability to identify, formulate, and solve problems in the field of Informatics
ELO 4	Professionalism Skill	Have the ability to work independently, quality, and measurable
ELO 5	Research Experience	Have the ability to study the implementation of Informatics science and compile a scientific description of the results of the study

ELO 6	Teamwork Skill	Have the ability to work in a team and be able to evaluate team performance
ELO 7	Scientific Expertise	Have knowledge in the field of Informatics and engineering as well as other special skills
ELO 8	Technical Proficiency	Have the ability to utilize and apply technical and theoretical methods in engineering activities in the field of Informatics
ELO 9	Entrepreneurial Knowledge	Have the ability to develop entrepreneurial concepts in the field of Informatics
ELO 10	Lifelong Learning	Have a high awareness of the importance and need for lifelong learning

E. MBKM Program

The Informatics Study Programme provides 6 activities outside the study program as a realization of the MBKM curriculum, namely:

1. Internship
2. Entrepreneurship
3. Research
4. Village Project
5. Independent Project
6. Student Exchange

Total credits for MBKM programs are 40 credits which are distributed equally for the 6th semester of 20 credits and the 7th semester of 20 credits.

Provision:

1. Students are required to take an internship of at least 1 semester
2. Students can choose one of 5 other MBKM activities besides internships
3. Students are at least in semester 5
4. There is a selection process for each activit

G. Distribution of Courses per Semester

The structure of the course in Informatics in 2022/2023 Academic Year :

Table 3.Curriculum Structures

1st Semester							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Compulsory	IF130	Programming fundamentals	3	0	C	Prerequisite : -
2	Compulsory	IF120	Discreate mathematics	3	0	C	Prerequisite : -
3	Compulsory	CE121	Linear algebra	3	0	C	Prerequisite : -
4	Compulsory	CE232	Digital System	3	0	C	Prerequisite : -
5	Compulsory	UM162	Pancasila	2	0	C	Prerequisite : -

6	Compulsory	UM152	Religion	2	0	C	Prerequisite : -
7	Compulsory	UM163	Civics	2	0	C	Prerequisite : -
8	Compulsory	UM122	English 1 : Composition	2	0	C	Prerequisite : -
Sum of 1st semester				20	0		

2nd Semester							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Compulsory	IF260	Operating system	2	1	C	Prerequisite : -
2	Compulsory	IF232	Algorithm&data structure	3	1	C	Prerequisite : IF130 Programming Fundamentals
3	Compulsory	IF231	Introduction to Internet Technology	2	1	C	Prerequisite : -
4	Compulsory	MSC1003	Communication and Personal Relationships	2	0	C	Prerequisite : -
5	Compulsory	EPM101	Calculus	3	0	C	Prerequisite : -

	Compulsory	CE332	Computer architecture and organization	3	0	C	Prerequisite : -
	Compulsory	UM223	English 2 : Speaking	2	0	C	Prerequisites : UM122 English 1 : Composition
Sum of 2nd semester				17	3		
3rd Semester							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Compulsory	IF350	Software Engineering and Project Management	3	0	C	Prerequisite : -
2	Compulsory	IF330	Web Programming	2	1	C	Prerequisite : IF231 Introduction to internet technology
3	Compulsory	IF331	Declarative Programming	3	0	C	Prerequisite : IF230 Algorithm and data structure
4	Compulsory	IF332	Language Theory and Automata	3	0	C	Prerequisite : IF120 Discrete Mathematics
5	Compulsory	IF351	Database System	2	1	C	Prerequisite : -

6	Compulsory	CE311	Probability and Statistics	2	0	C	Prerequisite : IF120 Discrete Mathematics
7	Compulsory	UM142	Bahasa Indonesia	2	0	C	Prerequisite : -
Sum of 3rd semester				17	2		
4th semester							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Compulsory	IF433	Object oriented programming	2	1	C	Prerequisite : IF230 Algorithm and data structure
2	Compulsory	IF470	Computer security	3	0	C	Prerequisite : -
3	Compulsory	IF420	Numerical analysis	3	0	C	Prerequisite : EP 101 Calculus
4	Compulsory	IF450	Human and Computer Interaction	3	0	C	Prerequisite : -
5	Compulsory	IF432	Algorithm design and analysis	3	0	C	Prerequisite : IF230 Algorithm and data structure
6	Compulsory	IF440	Artificial Intelligence	3	0	C	Prerequisite : CE311 Probability and Statistics

7	Compulsory	CE449	Computer Network	2	0	C	Prerequisite : -
Sum of 4th semester				19	1		
Semester 5							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Compulsory	IF580	Computer graphics and animation	2	1	C	Prerequisite : -
2	Compulsory	IF540	Machine learning	2	1	C	Prerequisite: IF440 artificial intelligence
3	Compulsory	IF570	Mobile app programming	2	1	C	Prerequisite : IF433 Object-oriented programming
4	Compulsory	IF541	Expert system	3	0	C	Prerequisite: IF440 Artificial intelligence
5	Compulsory	IF590	Information technology research	2	0	C	Prerequisite : UM142 Indonesian language
6	Compulsory	EM604	Technoprenerurship	2	0	C	Prerequisite : -
7	Compulsory	UM321	English 3 :Academic writing	2	0	C	Prerequisites : UM223 English 2: speaking

			Sum of 5th semester	15	3		
Elective courses – open in Odd and Even Semester							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Elective	IF680	Multimedia concepts	3	0	C	Prerequisite : -
2	Elective	IF681	3D game design and development	1	2	C	Prerequisite : IF433 Object-oriented programming
3	Elective	IF682	AR VR Game Design and Development	1	2	C	Prerequisite : IF433 Object-oriented programming
4	Elective	IF670	Cross Platform Mobile Programming	2	1	C	Prerequisite : IF433 Object-oriented programming
5	Elective	IF671	Blockchain and Cryptocurrency	2	1	C	Prerequisite : IF230 Algorithm and data structure
6	Elective	IF672	Paralel processing	2	1	C	Prerequisite : IF432 Algorithm design and analysis
7	Elective	IF673	Cybersecurity : Firewall configuration and management	2	1	C	Prerequisite : IF470 Computer Security

8	Elective	IF674	Cybersecurity : Cloud security and security operation	2	1	C	Prerequisite : IF470 Computer Security
9	Elective	IF690	Computers and Society	3	0		Prerequisite : -
8th semester							
#	Status	Code	Course	Credits		Min Pass	Description
				Th	Pr		
1	Compulsory	IF800	Thesis	0	6	C	Prerequisites: IF590 Information Technology Research, have followed IF726 Internship or Track 1 Internship, no grades D, E and/or F
2	Depends – Compulsory	IF726	Internship	0	4	C	Prerequisite: pass min. 100 credits, has Max 2 D grades and no E and/or F grades.

MBKM Scheme

Table 4. Internship Track 1 (Mandatory)

Code	Courses	Credits
IFM601	Professional Business Ethics	3
IFM602	Industry Experience	7
IFM603	Industry Model Validation	7
IFM604	Evaluation and Reporting	3
Total credits		20

Table 5. Internship Track 2

Code	Courses	Credit
IFM701	Industry Pipeline Knowledge	6
IFM702	Professional Literacy	4
IFM703	Industry Pipeline Validation	4
IFM704	Industry Based Project	6
Total credits		20

Table 6. Enterpreneurship

Code	Courses	Credits
IFM711	Idea validation	4

IFM712	Product validation	4
IFM713	Business validation	5
IFM714	Business mentoring	7
Total Credits		20

Table 7. Research

Code	Courses	Credits
IFM721	Research problem formulation	4
IFM722	Implementation of research methodology	7
IFM723	Research evaluation	4
IFM724	Scientific Publication	5
Total credits		20

Table 8. Village Project - Community Service Program

Code	Courses	Credits

IFM731	Community outreach project idea	3
IFM732	Community outreach (phase 1)	7
IFM733	Socio entrepreneurship development & managing	7
IFM734	Community outreach (phase 2)	3
Total credits		20

Table 9. Independent Project

Code	Courses	Credits
IFM741	Generation	4
IFM742	Design creation	4
IFM743	Development and evaluation	8
IFM744	Publication	4
Total SKS		20

Curriculum Detail

Body of Knowledge Informatics Study Programme

The Informatics study programme is based on curriculum design with the ACM Computing Curricula specification that have been used internationally. The details are as follows and the relationship between study material and topics in Informatics shown in Fig. 1.

Topics in Informatics Study Programme based on ACM Computing Curricula :

1. Character Building
2. Mathematics and Statistics
3. Algorithms and Programming
4. Smart System
5. Software Engineering
6. Computer Architecture
7. Distributed System
8. Life Skills

Body of Knowledge in Informatics study programme are :

1. Architecture and Organization (AL)
2. Computational Science (CN)
3. Discrete Structures (DS)
4. Graphics and Visualization (GV)
5. Human Computer Interaction (HCI)
6. Information Assurance and Security (IAS)
7. Information Management (IM)
8. Intelligent System (IS)
9. Networking and Communication (NC)
10. Operating Systems (IS)
11. Platform Based Development (PBD)
12. Parallel and Distributed Computing (PD)
13. Programming Languages (PL)
14. Software Development Fundamentals (SDF)
15. Software Engineering (SE)
16. System Fundamentals (SF)
17. Social Issues and Professional Practice (SP)

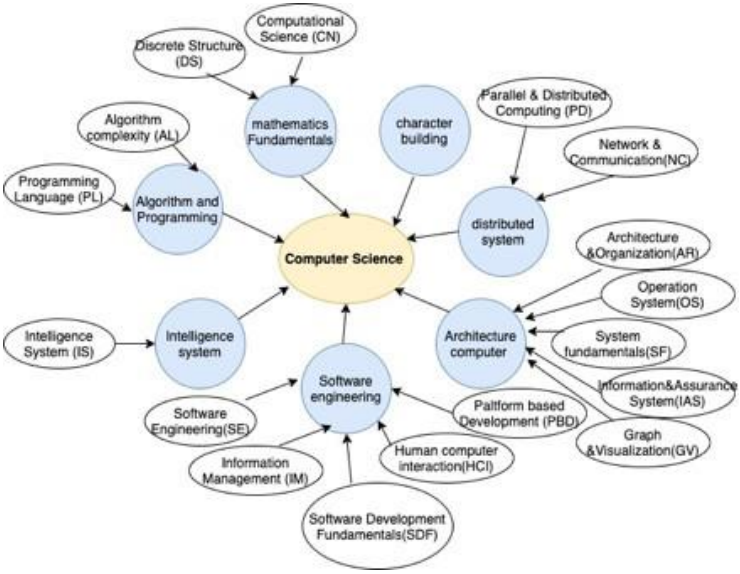

Fig 1. Body of Knowledge of Informatics Study Programme

Courses Definition

Semester 1

Code	Course name	Definition
IF130	Programming fundamentals	This course discusses the design of structured programs, using flowchart and pseudocode, which includes branching, iteration, desk checking, and modular.
IF120	Discrete mathematics	Discrete Mathematics aims to teach students to know and understand the basic concepts of Discrete Mathematics. Some of the materials taught in this course include the basic ideas of sets; Mathematical logic and proof; basic concepts of functions,

		sequences, and series; relations and relation matrices; introduction to number theory; calculation method; discrete opportunities; recurrence relation; graph and tree theory; and Boolean algebra and circuit combinatorial.
CE121	Linear Algebra	This course covers matrix theory and linear algebra, emphasizing topics useful in computer engineering field
CE232	Digital System	This course covers basic digital system including concept of digital system, numbering system and conversion, logic simplification, combination circuit, and sequential circuit
UM162	Pancasila	This course discusses Pancasila as the basic values of philosophy (philosophical grondslag), the soul of the nation (volksgeist) or the identity of the nation (innerself of nation), ideology of Indonesia, and way of life of the real Indonesia.
UM152	Religion	This course discusses the Divine Godhead as taught by every Religion in Indonesia and its implications on human life, upholding universal values.
UM163	Civics	This course develops students' basic competencies to become scientists and professionals who have a sense of nationality and love of the motherland; democratic society; become competent citizens,

		disciplined, and actively participate in building a peaceful life based on the Pancasila value system.
UM122	English 1 : Composition	This course discusses the elements of English to enrich the vocabulary, improve the pronunciation of words and improve students' knowledge related to sentence construction, paragraphs and texts that are focused on the development of reading skills, vocabulary skill-building and vocabulary learning strategies.

Semester 2

Code	Course name	Definition
IF260	Operating System	This course covers operating systems, processes and threads, concurrency, process scheduling, memory management, multiprocessor, process synchronization, device settings, deadlock and solving, and file systems.
IF232	Algorithm & Data structure	This course equips students with knowledge of algorithms and data structures in programming.
IF231	Introduction to Internet technology	This subject teaches the basic concepts of Web programming using client-side scripting.
MSC1003	Communication and Personal Relationships	The subjects include understanding, scope, concepts and axioms of communication, culture in

		interpersonal communication, perception and self in interpersonal communication, listening in interpersonal communication, interpersonal messages: verbal, nonverbal, emotion, and conversation, interpersonal relationships, interpersonal development and fractures, types of interpersonal relationships: friendship, romance, family and workplace, conflict and interpersonal conflict management, power and influence in interpersonal relationships.
EPM101	Calculus	This course provides basic concepts of limits and continuity; definitions, properties and derivative formulas and their applications; definitions and properties of transcendent functions and their applications; definitions, traits, indefinite integral and definite, derivatives and integrals of multivariable functions, application problems, and more.
CE332	Computer Architecture and Organization	This course introduces details of computer architecture and organization. It covers computer top level view, memory types and hierarchies, I/O and Storage devices, CPU architectures such as RISC, CISC,

		parallel, multi-core and GPGPU systems
UM232	English 2 : Speaking	This course discusses the concepts and processes of writing scientific articles (planning, designing, reviewing and editing) from writing paragraphs to writing essays, introducing literary variety and discussing the factors that influence the production of a good quality and well-written writing, as well as fostering students' writing habits.

Semester 3

Code	Course name	Definition
IF350	Software Engineering and Project management	This course student will apply the principles and approaches of software engineering theory and practice and manage them into a software project management that is efficient, within budget, quickly and of good quality. Student will develop a comprehensive project plan using the project of their choice. By the end of this course, student will understand why project management requires a high level of professionalism, and how to achieve that goal in future software projects
IF330	Web Programming	This course covers web programming using server side scripting (eg. PHP) and database.

IF331	Declarative programming	Declarative programming is a programming paradigm in which a computer program is formed based on a computational logic structure that can be used to solve a problem. In declarative programming, the source code of a program does not express the control flow of a problem solving. The purpose of using declarative programming is to minimize and eliminate side effects (in the form of bugs) from a program by describing what must be solved based on a problem domain. By understanding declarative programming, besides being able to create programs that are free from side effects, users can also write parallel programs more easily. Logical programming and functional programming are two parts of the declarative programming paradigm. This course will specifically discuss logic programming as part of declarative programming
IF332	Language Theory and Automata	This course studies the formal language, especially for the purposes of designing a compiler and a text processor. Automata are abstract machines that can recognize, accept, or generate a sentence in a particular language. The theory of language and automata is a theory of

		abstract machines, and is closely related to formal language theory
IF351	Database System	This course covers the concepts, terminology, technique used in database management systems.
CE311	Probability and Statistics	This course provides the basics of probability distribution and statistical analysis methods, relevant for students of information and communication technology.
UM142	Bahasa Indonesia	This course covers the status and function of Bahasa Indonesia (Indonesian Language), traits of Bahasa Indonesia, variety / barrel of language, word and word formation, choice of words, sentences and sentence patterns, the effectiveness of sentences,paragraph development and paragraph sequencing, paraphrase, systematic scientific writing, writing excerpts with the APA system, completeness of papers, oral proficiency in presentations, interviews and arguments.

Semester 4

Code	Course name	Definition
IF433	Object Oriented Programming	This course deals with the basic concepts of object-oriented programming and Java and C ++ programming (Control Structure, I / O Stream,

		Function, Array, Pointer, String, Class, Overloading Operator, File, etc.)
IF470	Computer Security	This course provides basic concepts and general knowledge of computer security, many kinds of attacks, harms caused by those attacks, vulnerabilities causing many kinds of attacks, threats which can exploit those vulnerabilities and cause security breach, and countermeasures against many kinds of attacks
IF420	Numerical Analysis	In the Numerical Analysis course, students will be introduced to various numerical concepts, ranging from Linear Algebra and Systems of Linear Equations, Eigen values and vectors, Least Square Regression, Interpolation techniques, Taylor series, techniques for finding the roots of equations, Numerical derivatives, Integration Numerics, Ordinary Differential Equations, and Fourier Transforms. In addition, this course is also equipped with various examples of problems and practical application of solving these problems using basic Python programming which is introduced to students.
IF450	Human and Computer Interaction	This course provides knowledge that focuses on fundamental concepts to real-world implementation examples of the principles of

		human-computer interaction in the world of information technology. Theories and techniques of analysis and design of human and computer interactions are explained with an understanding that most of them are in the realm of knowledge of informatics and computer engineering as well as a small part of human psychology in interacting with computers, general digital knowledge of today's interfaces and applications, and real world conditions in society. related to interactive products in the world of information technology
IF432	Algorithm design and Analysis	This course discusses the analysis and design of algorithms that will be used to solve informatics problems where students will learn about the basic concepts of algorithms, algorithm analysis, algorithm design techniques, and how the algorithm works to solve a problem
IF440	Artificial Intelligence	This subject discusses the basic concepts of artificial intelligence and development, the concept follows the basic knowledge representation of knowledge, problem-solving techniques with search methods, and applications of intelligent systems applications in the field of artificial intelligence.

CE449	Computer Network	This course covers internetworking protocols (OSI and TCP / IP layers) and their implementation with a top-down approach, from the application layer to the physical layer.

Semester 5

Code	Course name	Definition
IF580	Computer Graphics and Animation	Computer Graphics and Animation teaches computer graphics in general, procedural programming, basic algorithms for 2D and 3D graphics, geometric transformations, graphics between face, lighting and animation. Apart from technical understanding, this course also teaches the history and application of computer graphics and animation in the industrial world
IF540	Machine Learning	Machine learning courses invite students to understand basic ideas, intuition, algorithm concepts and techniques to make computers smarter. Emphasis of material on technique the basis of guided, unsupervised, and reinforcement learning. Students are introduced to problem areas and problem boundaries in machine learning which include classification and group analysis. Inviting students to

		understand and measure system performance, system optimization techniques and overcome overfitting problems, carry out preprocessing data, recognize data and its properties, and how to validate the correct model. Some of the algorithms used in developing machine learning based systems are presented to students are preprocessing data with principal component analysis and linear discriminant analysis, prediction-based models with regression, Gaussian-based modeling, modeling based on Bayes classification, decision tree based model, nearest neighbor based model, support vector based modeling, deep learning, partition algorithm, hierarchical algorithm, algorithm density based, association based algorithm, Q-Learning algorithm and SARSA
IF570	Mobile App Programming	This course provides the basic knowledge required by an Android mobile application programmer, such as the use of activity, fragments, and intents; UI concept on Android; utilization of views, data management; sharing data; Android messaging feature; location-based services and

		Android services; Android networking; and Android application publishing, both theoretically and practically.
IF541	Expert System	This course aims to teach the students to know and understand basic concept of Expert System and its applications. Some materials being taught in this course are ranging from the basic concept of an Expert System and the system's structure; Genetic Algorithm; some metaheuristic techniques (Particle Swarm Optimization, Ant Colony Optimization, Simulated Annealing, and Cross Entropy); and some Multi Criteria Decision Making techniques (Weighted Product Model, ELECTRE, TOPSIS, AHP, and Fuzzy-based MCDM). Moreover, the students will be given an experience to solve a problem by using the skills and knowledge they have learnt in the form of a group project.
IF590	Information Technology Research	Information Technology Research is a supporting course for the Thesis Course which contains the basic materials needed to ensure the success of a research project, such as the introduction of research in the field of Informatics Engineering, the basic

		concepts and stages of research, the basics of developing a research proposal, how to refer, test, and withdraw conclusions and research suggestions, and how to present research results, both orally and in writing
EM604	Technopreneurship	This course is about entrepreneurship based on Information and Communication Technology. This course is unique as students not only learn about entrepreneurship but also include creating an innovative idea by putting forward the latest technological aspects, realizing the idea to become a product or service, and how to deliver the product or service to the consumers.
UM321	English 3 : Academic Writing	This course covers methods, concepts and elements of language to improve listening and speaking skills in English which will enable students not only to understand and produce sentences related to grammatical, lexical and articulate elements but also to enable students to understand when, where, why and what ways should be applied to language production.

Elective Courses (6th or 7th Semester)

Code	Course name	Definition
IF680	Multimedia Concept	Multimedia concept teaches students the basic understanding of the concept of using multimedia elements and their processing in the real world. This course teaches various terms, definitions, technical meanings and techniques for using multimedia elements consisting of text, image, audio, video, and animation. In addition, students are also taught to complete a multimedia project in the form of collaborative interactive multimedia applications. The technique of using multimedia elements and making interactive multimedia projects is done using the Visual Scratch programming language as a multimedia authoring tool
IF681	3D game design and development	This course discusses the process of making a digital game in 3-dimensional form, starting from the process of designing elements in a game and using three-dimensional assets from 3D software, to the process of implementing and programming a digital game in three-dimensional form. Before entering into the process of designing elements in a game, students will be taught the concept of elements in a game

		according to several experts in the field of Game Design and Development. The implementation and programming technology taught in this course will use the Unity Game Engine as a digital game development tool.
IF682	AR VR game design and development	This course discusses the process of making a digital game in 3-dimensional form by utilizing tools related to making game development such as smartphones to create Virtual Reality games or Augmented Reality games and also learning how to make games using procedural content generation methods by utilizing Unity software.
IF670	Cross Platform mobile programming	Cross-Platform Mobile Programming discusses how to build a hybrid mobile app using various web technologies that can run on Android and iOS platforms using the same codebase. Students will also learn how to build mobile applications that can access native device features, such as cameras, sensors, geolocation, and access cloud-based databases
IF671	Blockchain and Cryptocurrency	This course explores the potential use of blockchain technology by various stakeholders related to economics and finance. Starting with a review of the

		early applications of the technology, Bitcoin cryptocurrency, students will gain an understanding of the commercial, technical, and public policy underpinnings of blockchain technology, distributed ledgers, and contracts smart contracts in open source and private applications. The discussion covers current blockchain applications with case reviews from payment systems to non-fungible tokens (NFT).
IF673	Cybersecurity : Firewall configuration and management	This course provides students with a general understanding of how to install, configure, and manage firewalls for network architecture defense. Students will learn theory and configuration steps for setting up security, networking, threat prevention, logging, and reporting features of firewall technology. Students will also learn the theory and advanced configuration features needed to set up traffic handling, advanced content/user identification, quality of service, global protection, monitoring/reporting, and high availability using firewall technology.
IF674	Cybersecurity : Cloud security and security operation	This course provides the students basic principles associated with securing the cloud and SaaS-based

		applications through Secure Access Service Edge architecture and identify concepts required to recognize and potentially mitigate attacks against traditional and hybrid datacenters as well as mission critical infrastructure. Students will also learn how to initially setup and configure containers on a Docker bridge network and test the container security through the use of vulnerability scans and reports. This course also provides the student with an understanding of Security operations (SecOps) and the role it plays in protecting our digital way of life, for businesses and customers. Students will learn continuous improvement processes to collect high-fidelity intelligence, contextual data, and automated prevention workflows that quickly identify and respond to fast-evolving threats. They will also learn how to leverage automation to reduce strain on analysts and execute the Security Operation Center's (SOC) mission to identify, investigate and mitigate threats
IF690	Computer and Society	The rapid development of ICT (Information and Communication Technology) has changed many activities in our lives. For example, in

		learning, playing, working,communicating and doing business. Moreover, now social media has also been widely used in various ways. In addition to having a positive impact, the development of ICT also has a negative impact. This negative impact needs to be understood so that the community using ICT can minimize its impact. To that end, the Indonesian government has drawn up various laws, including the Law on Information and Electronic Transactions to regulate the use of ICT in society. As an ICT professional, it is not enough just to master the technology but also to understand the code ethics to prevent the misuse of ICT, both for personal interests and the interests of other parties.

Semester 8

Code	Course name	Definition
IF726	Internship	
IF800	Thesis	

Mapping Body of Knowledge (BoK) and Courses

As the relevance of topics in Informatics Study Program, the Body of Knowledge are mapping along with courses in study program in the following table :

Table 10. BoK and Courses

No	Topic	Body of Knowledge	Related Course
1	Character building		Religion, Pancasila, Bahasa Indonesian, Civics, English 1,English 2, English 3
2	Mathematics and Statistics	Discrete Structure(DS), Computational Science (CN)	Discrete mathematics, linear algebra, Calculus, Probability and statistics, Numerical Analysis
3	Algorithms and Programming	Algorithm and complexity (AL), programming language (PL)	Programming Fundamentals, Algorithms & Data structure, Intro.to Internet Technology, Web Programming, Declarative Programming, Language Theory and Automata, Object Oriented Programming
4	Smart System	Intelligence System (IS)	Artificial Intelligence, Machine Learning, Expert Systems
5	Software Engineering	Software Engineering(SE), Information management (IM), System Development Fundamentals (SDF), Human Computer Interaction (HCI), Platform Based	Database Systems, Software Engineering and Project Management, Human and Computer Interaction, Algorithm Design and Analysis, Multimedia Concept, 3D game design and development, AR VR

		Development(PBD)	game design and development
6	Computer Architecture	Architecture and Organization (AR), Operating System (OS), System Fundamentals (SF), Information & Assurance System (IAS), Graphics and Visualization (GC)	Digital Systems, Operating system, Computer Architecture and Organization, computer security, Parallel Processing, Cybersecurity : firewall configuration and management, Cybersecurity : Cloud security and security operation
7	Distributed System	Parallel Distribution (PD), Network and Communication (NC)	Computer Network, Computer Graphics and animation, Mobile App Programming, Cross Platform Programming, Block chain and Cryptocurrency
8	Life Skills	Social Issue and Professional Practice (SP)	Computer and Society, technopreneurship, Interpersonal Communication, Internship, Thesis

Mapping Expected Learning Outcome (ELO) – see Table.2 and Courses

Table 11. ELO and Courses

No	Code	Course	ELO
1	IF130	Programming Fundamentals	ELO 4; ELO 7
2	IF120	Discrete mathematics	ELO 3; ELO 7
3	CE121	Linear Algebra	ELO 3
4	CE232	Digital system	ELO 3
5	UM162	Pancasila	ELO 1; ELO 10
6	UM152	Religion	ELO 1; ELO 10
7	UM163	Civics	ELO 1 ; ELO 10
8	UM122	English 1 : composition	ELO 2
9	IF260	Operating system	ELO 3; ELO 4; ELO 7; ELO 8
10	IF230	Algorithm and Data Structure	ELO 2; ELO 3; ELO 4; ELO 6; ELO 7; ELO 8
11	IF231	Introduction to Internet Technology	ELO 3; ELO 4; ELO 7; ELO 8
12	MSC1003	Communication and Personal Relationships	ELO 2
13	EP101	Calculus	ELO 3
14	CE332	Architecture and Computer Organization	ELO 3

15	UM223	English 2 : talking	ELO 2
	IF350	Software engineer and project management	ELO 3; ELO 6; ELO 7
16	IF330	Web programming	ELO 3; ELO 4; ELO 7; ELO 8
17	IF331	Declarative programming	ELO 3; ELO 7
18	IF332	Language theory and automata	ELO 3;ELO 7
19	IF351	Database system	ELO 3; ELO 4;ELO 7; ELO 8
20	CE311	Probability and statistics	ELO 3
21	UM142	Indonesia Language	ELO 2
22	IF433	Object oriented programming	ELO 3; ELO 4; ELO 7; ELO 8
23	IF470	Computer security	ELO 1; ELO 3; ELO 7
24	IF420	Numerical analysis	ELO 3; ELO 7
25	IF450	Human computer interaction	ELO 2; ELO 3; ELO 7
26	IF432	Design and analysis algorithm	ELO 3; ELO 7
27	IF440	Artificial intelligence	ELO 3; ELO 6; ELO 7

28	CE449	Computer network	ELO 1; ELO 3; ELO 7
29	IF580	Computer graphics and animation	ELO 3; ELO 7; ELO 10
30	IF540	Machine learning	ELO 3; ELO 7; ELO 10
31	IF570	Mobile application programming	ELO 2; ELO 3; ELO 7
32	IF541	Expert System	ELO 6; ELO 7; ELO 10
33	IF590	Information Technology Research	ELO 1; ELO 2; ELO 3; ELO 7
34	EM604	Technopreneurship	ELO 2; ELO 4; ELO 6
35	UM321	English 3 : academic writing	ELO 2
36	IF680	Multimedia concepts	ELO 2; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
37	IF681	3D game design and development	ELO 2; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
38	IF682	AR VR game design and development	ELO 2; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
39	IF670	Mobile cross platform programming	ELO 2; ELO3; ELO 4; ELO 6; ELO 7; ELO 8

40	IF671	Blockchain and cryptocurrency	ELO 2; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
41	IF672	Parallel programming	ELO 2; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
42	IF673	Cybersecurity : firewall configuration and management	ELO 1; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
43	IF674	Cybersecurity : cloud & operation security	ELO 1; ELO3; ELO 4; ELO 6; ELO 7; ELO 8
44	IF690	Computer & society	ELO 1; ELO 2; ELO 3; ELO 7
45	IF800	Thesis	ELO 1; ELO 2; ELO 3; ELO 5; ELO 7; ELO 8; ELO 10
46	IF726	Internship	ELO 1; ELO 2; ELO 5; ELO 7; ELO 8; ELO 10