KURIKULUM 2018

Computer Engineering Dept.
Faculty of Electrical Technology

Institut Teknologi Sepuluh Nopember

FACULTY OF ELECTRICAL TECHNOLOGY

Program Studi	**Computer Engineering**
Jenjang Pendidikan	**SARJANA**

Learning Achievements		
BEHAVIOR	S01	Belief in the Almighty God and showing a religious attitude
	S02	Uphold humanistic values in carrying out duties based on religion, morals, and ethics
	S03	Contributing to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila
	S04	Serve as a proud citizen of the nation, with strong nationalism and a sense of responsibility to the state and nation
	S05	Respect the diversity of cultures, views, religions, and beliefs, as well as the opinions or findings of others
	S06	Cooperate and having social sensitivity and concern for society and environment
	S07	Obey the law and discipline in social and state life
	S08	Internalized academic values, norms, and ethics
	S09	Demonstrated responsibility towards the work in the field of expertise independently
	S10	Internalizing the spirit of independence, struggle, and entrepreneurship
	S11	Trying to the fullest to achieve perfect results.
	S12	Working together to be able to take full advantage of each others' potential.

Learning Achievements		
GENERAL KNOWLEDGE	P01	Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security.
	P02	Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security
	P03	Theoretical concepts and techniques for the implementation of advanced computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Devices, Embedded Systems and Robotics.
	P04	Principles and techniques for designing computer systems and networks, encompassing hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security.
	P05	Current principles and issues related to economic, occupational health and safety, social, and ecological factors in general
	P06	The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security

Learning Achievements		
GENERAL SKILLS	KU01	Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise
	KU02	Ability to demonstrate independent, quality, and measurable performance
	KU03	Ability to examine the implications of developing or implementing the science of technology that concerns and implements the value of humanities according to their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticisms
	KU04	Develop a scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page
	KU05	Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis
	KU06	Ability to maintain and develop a network with mentors and colleagues, both inside and outside the institution
	KU07	Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the workers under his / her responsibility.
	KU08	Ability to conduct self-evaluation process to workgroups under his/her responsibility, and able to manage independent learning.
	KU09	Ability to document, store, secure, and rediscover data to ensure validity and prevent plagiarism
	KU10	Ability to self-improve and compete in national and international level
	KU11	Ability to implement sustainable principles in developing knowledge
	KU12	Ability to implement information and communication technologies in the context of execution of activity
	KU13	Ability to apply entrepreneurship concepts and understand technology-based entrepreneurship

Learning Achievements		
SPECIAL SKILLS	KK01	Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics.
	KK02	Ability to design modern computer systems, computer-based systems, and modern computer networks that include hardware and software and integration to solve problems in the field of current engineering.
	KK03	Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security
	KK04	Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security
	KK05	Ability to find the source of engineering problems in modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security through the process of investigation, analysis, interpretation of data and information based on engineering principles
	KK06	Ability to conduct research that includes identification, formulation and analysis of engineering problems on modern computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security.

Learning Achievements		
	KK07	Ability to formulate solutions to engineering problems in modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, taking into account economic, health and safety, cultural, social and environmental factors,
	KK08	Ability to design modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, as per applicable technical, safety and health standards with respect to performance and reliability aspects, application and sustainability, ease and convenience of use and taking into account economic, health and safety, public, cultural, social and environmental factors.
	KK09	Ability to select resources and utilize design tools and engineering analysis based on appropriate information, communications and computing technology to perform engineering activities on modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security.

DAFTAR MATA KULIAH

No.	Kode MK		Nama Mata Kuliah (MK)	S

SEMESTER I

1			Matematika I	3
2			Fisika I	4
3			Agama	2
4			Pancasila	2
5			Bahasa Inggris	2
6		EW184101	Pengantar Teknologi Elektro	2
7		EW184102	Dasar Pemrograman Komputer	3
			Jumlah SKS	**18**

SEMESTER II

1			Matematika II	3
2			Fisika II	3
3			Kewarganegaraan	2
4			Bahasa Indonesia	2
5			Kimia	3
6		EW184201	Rangkaian Listrik	2
7		EC184201	Pemrograman Lanjut	3
			Jumlah SKS	**18**

SEMESTER III

1		EC184301	Aljabar Linier dan Matematika Diskrit	4
2		EC184302	Sistem Telekomunikasi	2
3		EC184303	Rangkaian elektronika	3
4		EC184304	Struktur data dan Analisa Algoritma	3
5		EW184301	Metode Numerik	3
6		EC184205	Sistem Operasi	3
			Jumlah SKS	**18**

SEMESTER V

1		EC184501	Jaringan Komputer dan lab	4
2		EC184502	Arsitektur dan Organisasi Sistem Komputer	3
3		EC184503	Pembelajaran mesin	3
4		EC184504	Pengolahan Citra dan Video	3
5		EC184505	Sistem Mikroprosesor dan Mikrokontroller	3
6			Mk Pilihan 1	3
			Jumlah SKS	**19**

SEMESTER VI

1		EC184601	Kerja Praktik	2
2		EC184602	Pemrograman Sistem dan Jaringan	3
3		EC184603	Embedded Systems dan lab	4
4		EC184604	Visi Komputer	3
5			Teknopreneur	2
6			Mk Pilihan 2	3
7			Mk Pilihan 3	3
			Jumlah SKS	**20**

SEMESTER VII

1		EC184701	Pra Tugas Akhir	2
2		EC184702	Proyek Telematika	3
3		EC184703	Jaringan Sensor Nirkabel dan IoT	4
4		EC184704	Sekuriti Sistem Komputer	3
5			Mk Pilihan 4	3
6			Mk Pilihan 5	3
			Jumlah SKS	**18**

SEMESTER VIII

1			Wawasan dan Aplikasi Teknologi	3
2			MK Pengayaan	3
3		EC184802	Kompetensi Teknologi Elektro	3
4		EC184801	Tugas Akhir	6
			Jumlah SKS	**15**

MATA KULIAH PILIHAN

No.	KODE	Mata Kuliah Pilihan	SKS
1	EC184901	Desain Permainan	3
2	EC184902	Kecerdasan Komputasional untuk Permainan	3
3	EC184903	Digital Forensik	3
4	EC184904	Komputasi Terdistribusi	3
5	EC184905	Komputasi untuk Klaster dan Multi Prosesor	3
6	EC184906	Komputasi Ubiquitous	3
7	EC184907	Sistem Komputasi Grid & Cloud	3
8	EC184908	Rekayasa Jaringan Internet	3
9	EC184909	Multimedia Bergerak	3
10	EC184910	Web Intelligent & Big Data	3
11	EC184911	Visualisasi Citra Medis	3
12	EC184912	Interaksi Komputer Manusia	3
13	EC184913	Grafika Komputer	3
14	EC184914	Pemrograman Mobile Robot	3
15	EC184915	Analisis Citra Medis	3
16	EC184916	Perangkat Terprogram	3
17	EC184917	Probabilistik Robotic	3
18	EC184918	Sistem Konkurens Waktu Nyata	3
19	EC184919	Desain Aplikasi Bergerak	3
20	EC184920	Pemrograman Permainan	3

SEMESTER 1

	Course	**:**	**Computer Programming Basics**
	Course ID	:	EW184102
	Credit	:	3
	Semester	:	1

COURSE DESCRIPTION

In this course, students will learn about the history and development of computers, computer components and systems, algorithm concepts, data types, programming basics, structured programming, sequencing, repetition, selection, functions, and structure and file concepts.

EXPECTED LEARNING OUTCOME

- Internalized academic values, norms, and ethics. (S8)
- Demonstrated responsibility towards the work in the field of expertise independently. (S9)
- Mastered the theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK3)
- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses

hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK4)

- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise. (KU1)
- Ability to demonstrate independent, quality, and measurable performance. (KU2)

COURSE OBJECTIVES

- Ability to explain the components of a computer, including the central processing unit, memory, bus, and IO unit.
- Ability to explain how a computer system works.
- Ability to explain the concept of numbers and its symbols.
- Ability to explain the concept of algorithms and flowcharts, and be able to apply them to solve simple scientific problems.
- Ability to use expressions, operators, and operands in an algorithm.
- Ability to translate algorithms or flowcharts into the C programming language.
- Understand the concept of arrays, and are able to apply them to store and read arrays.
- Understand the concept of functions and passing parameters in the function, and are able to apply it to a use case.
- Understand the concept of record, and are able to apply it to save and read records.
- Understand the concept of arrays for records, and are able to apply them to store and read arrays from a record.
- Understand the concept of files and storing records on files, and are able to apply it to save records into files and read records from a file.

TOPICS

- Computer history
- Computer systems
- Number systems
- Expressions, operands and operators

- Computer algorithms, sequences, repetition and selection
- Flowchart
- C programming language
- Basic data types
- Array data type
- Simple data sorting
- Simple data searching
- Functions
- Record data type
- Files

PREREQUISITES

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REFERENCES

1. "Discovering Computers Fundamentals", Gary B. Shelly and Misty E. Vermaat, Cengage Learning, 8th Edition, 2012.
2. "Introduction to Algorithms", Thomas H. Cormen, MIT Press, 3th Edition, 2009.
3. "The C Programming Language", Brian Kernighan and Dennis Ritchie, -, 1978

SEMESTER 2

Course	**:**	**Advanced Programming**
Course ID	:	**EC 184201**
Credit	:	3
Semester	:	2

COURSE DESCRIPTION

In this course, students will learn about structured programming, data structures, dynamic storage, objects and classes, code reuse and encapsulation, and inheritance and polymorphism.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Principles and techniques for designing computer systems and networks, encompassing hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P4)
- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise (KU1)
- Ability to demonstrate independent, quality, and measurable

performance (KU2)

- Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics. (KK1)
- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

COURSE OBJECTIVES

- Understand the concept of records and array records, and are able to apply it to save and read array from a record.
- Understand the concept of dynamic storage for standard data, arrays, records and array records.
- Understand the concept of objects and classes.
- Understand the concept of software development with code libraries.
- Ability to explain object-based software systems.
- Ability to explain data abstraction into behavior-equipped objects.
- Ability to model the software system as a unified object.
- Ability to build object-oriented software

TOPICS

- Structured programming
- Data structures
- Dynamic storage
- Objects and classes
- Code reuse and encapsulation
- Inheritance and polymorphism

PREREQUISITES

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REFERENCES
1. "The C Programming Language", Brian Kernighan and Dennis Ritchie, -, 1978 2. "Object-Oriented Programming in C++", Fourth Edition, Robert Lafore, SAMS, 2002

SEMESTER 3

Course	**:**	**Linear Algebra & Discrete Mathematics**
Course ID	:	EC184301
Credit	:	4
Semester	:	3

COURSE DESCRIPTION

In this course, students will learn about linear algebra, vector, and matrix theories. Topics include linear equations, matrices, vector spaces, linear transformations, scalar products, orthogonality, eigenvalue, eigenvectors, and applications using linear algebraic foundations as its solution.
Students then will learn about discrete mathematics and its application in engineering. Some of the main subjects studied include sets, functions, algorithm complexity, mathematical inductions, number theory, relationships, and graph theory. The learning methods used in the course are lectures, discussions, case studies, quizzes, practice questions, and examinations.

EXPECTED LEARNING OUTCOME

- Uphold humanistic values in carrying out duties based on religion, morals, and ethics (S2)
- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)

- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)

- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise (KU1)

- Ability to demonstrate independent, quality, and measurable performance (KU2)

- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

COURSE OBJECTIVES

- Students are able to explain and apply the concept of linear equation systems for solving problems in engineering.
- Students are able to explain and apply the concept of matrices and vectors for solving problems in engineering.
- Students are able to explain and apply the concept of linear transformation and orthogonality to solve problems in engineering.
- Students are able to explain and apply eigenvalue and eigenvector concepts to solve problems in engineering.
- Students are able to design and implement linear algebra concepts for specific cases.
- Students are able to formulate logical sentences and determine

truth by logical inference.

- Students are able to formulate sets, inter-set functions, and algorithm complexities.
- Students are able to prove a sequence or series model using mathematical induction.
- Students are able to understand the principles of number theory and solve simple cryptographic problems.
- Students are able to formulate graph theory and solve simple graph problems.

TOPICS

- **Linear Equation System**: Gaussian elimination, echelon forms, solution existence and uniqueness, homogen system.
- **Matrix**: matrix operations, elementary matrix, matrix inversion, LU decomposition, linear equation system as matrices, matrix determinant, matrix properties, and Cramer rule.
- **Vector Spaces**: subspace, spanning set, linear independence, bases, dimension, row & column spaces in matrices, matrix rank, and null space in matrix.
- **Linear Transformation**: kernel & range, matrix representation, base change & matrix similarity.
- **Scalar Products & Orthogonality**: Cauchy-Schwarz & triangle inequalities, vector length & angle, Pythagorean theory, orthonomal sets, orthogonal complement of null space & column space, orthogonal projections, smallest quadrant, orthogonal matrix, Gram-Schmidt process, and QR factorization.
- **Eigenvalue &eigenvector**: complex eigenvalue, matrix diagonalization, spectral theory for symmetric matrix, quadratic form, positive definite matrix, and nonnegative matrix.
- **Logic** : Proposition, tautology, logic equation
- **Sets** : notation, cardinality, empty sets, operational sets
- **Functions**: domain, co-domain, range, bijective, inverse, ceiling, floor.
- **Algorithm complexity** : big – oh, big omega, big - theta
- **Number theory**: euclidean for GCD, decimal, binary, number bases

- **Proving techniques**: direct, induction, strong induction, recursive functions, recursive linier relation, homogen and non-homogen.
- **Relation**: definition, representation, closure, equivalent relation, partial ordering.
- **Graph theory**: definition, operation, special graphs, graph representation, isomorphism, connectivity, planar graph, graph coloring

PREREQUISITES

Mathematics I, Mathematics II

REFERENCES

- David C. Lay. "Linear Algebra and its applications", Pearson Education, 4th edition.
- Kreyszig, E, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, Singapore, 2011.
- Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw-Hill Science/Engineering/Math; 5 edition, 2003.

	Course ID	:	**EC 184304**
	Credit	:	3 SKS
	Semester	:	3

COURSE DESCRIPTION

In this course, students will study the data structures that can be used for programming. Topics include linked list, stack, queue, tree, binary search tree, AVL tree, tree traversal, various sorting and searching types.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Principles and techniques for designing computer systems and networks, encompassing hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P4)
- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise (KU1)
- Ability to demonstrate independent, quality, and measurable performance (KU2)
- Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer

systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics. (KK1)

- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

COURSE OBJECTIVES

- Students are able to explain and apply the basic data structure concepts: stack, queue, lists, and matrices.
- Students are able to explain and apply the concepts of tree and graph: tree, binary search tree, AVL tree, various sorting and searching types
- Students are able to explain and apply advanced data structure concepts: Huffman tree, Djikstra shortest path.
- Students are able to complete a case by using one or a combination of data structures that have been studied.
- Students are able to explain iterative and recursive algorithms

TOPICS

1. Data structure systems, algorithm analysis and its components
2. Basic data structure: stack, queue, lists, sequential allocation, linked allocation.
3. Matrices
4. Tree & Graph: tree, binary search tree, AVL tree,
5. Advanced data structure: skip lists, quadtrees, Huffman tree, Dijkstra

PREREQUISITES

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REFERENCES

1. "Data Structures and Algorithms", Granville Branett, 2008
2. Data Structures and Algorithm Analysis Edition 3.2 (C++ Version) Clifford A. Shaffer Department of Computer Science Virginia Tech Blacksburg, VA 24061 January 2, 2012.

Course	**:**	**Numerical Methods**
Course ID	:	EW 184301

	Credit	:	3
	Semester	:	3

COURSE DESCRIPTION

In this course, students will learn how to solve mathematical problems using numerical algorithm approaches. Topics include errors, number representation, Taylor's theorem, nonlinear equations, linear equations, interpolation, regression, numerical integration, numeric derivatives and differential equations.

EXPECTED LEARNING OUTCOME

- Uphold humanistic values in carrying out duties based on religion, morals, and ethics (S2)
- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise (KU1)
- Ability to demonstrate independent, quality, and measurable

performance (KU2)

- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

COURSE OBJECTIVES

1. Able to explain and implement methods to resolve errors, number representation, and Taylor's theorem.
2. Able to explain and implement methods to resolve nonlinear equations.
3. Able to explain and implement methods to resolve linear equations.
4. Able to explain and implement methods to resolve regressions.
5. Able to explain and implement methods to resolve interpolation.
6. Able to explain and implement methods to resolve numerical integration.
7. Able to explain and implement methods to resolve numerical derivatives.
8. Able to explain and implement methods to resolve differential equations.

TOPICS

- Error counting
- Taylor's theorem
- Non-linear equations
- Linear equations
- Interpolation
- Regression
- Numerical integration
- Numerical derivatives
- Differential equations.

PREREQUISITES

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REFERENCES
3. Greenbaum and T. P. Chartier. Numerical Methods: Design, Analysis and Computer Implementation of Algorithms. Princeton University Press, 2012. 4. W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery. Numerical Recipes: The Art of Scientific Computing. Cambridge University Press, 2007. 5. L. R. Scott. Numerical Analysis. Princeton University Press, 2011. 6. E. Suli, D. F. Mayers. An Introduction to Numerical Analysis. Cambridge University Press, 2003.

	Course ID	:	**EC 184205**
	Credit	:	3
	Semester	:	3

COURSE DESCRIPTION

In this course, students will learn how the operating system works and the elements that make up an operating system. Topics include operating system history, operating system structure, scheduling, threads & concurrency, synchronization, deadlock, memory management, I/O interfaces, disks & filesystems, operating system security, and an introduction to distributed systems.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Principles and techniques for designing computer systems and networks, encompassing hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P4)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)

- Ability to demonstrate independent, quality, and measurable performance (KU2)
- Ability to design modern computer systems, computer-based systems, and modern computer networks that include hardware and software and integration to solve problems in the field of current engineering. (KK2)
- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK4)

COURSE OBJECTIVES

- Students are able to recognize and explain the operating system and its elements and structure.
- Students are able to explain scheduling techniques in the operating system.
- Students are able to explain the phenomenon of concurrency, synchronization and deadlock.
- Students are able to explain about memory management.
- Students are able to explain about the system files.
- Students are able to explain the security stages in the operating system.
- Students are able to explain the process scheduling model in a distributed system.

TOPICS

- **Operating system history**: Operating system design, history batch processing, multiprogramming, timesharing.
- **Operating system structure**: Process, Process Control Block (PCB), system call
- **Scheduling**: Process cycle, Preemptive and non-preemptive system, scheduling algorithms (FCFS, Round Robin, SJF, dll).

- **Threads and concurrency**: Process communication methods (message passing, pipe, shared memory), thread, thread cycle, thread control block (TCB), user & kernel thread
- **Synchronization**: Race Condition, atomic operation, critical section, mutex, semaphore, monitor.
- **Deadlock**: deadlock, resource allocation, deadlock handling and preventation.
- **Memory**: Uniprograming, multiprograming, address translation, manajemen memori (first fit, best fit, worst fit), fragmentation, virtual memory, paging, virtual address translation, TLBs, multilevel paging, hash table, page faults, page replacement algorithms (FIFO, optimal, LRU, clock, second chance, working set,), segmentation.
- **I/O interface**: I/O architecture, pooling, interrupt, direct memory access (DMA), buffering, caching
- **Disks**: Disk anatomy, disk head scheduling, partition.
- **File system**: Files, directory, block, sector, contiguous allocation, linked files, direct allocation, indexed files, multilevel indexed files, UNIX indexed allocation, basic file operation (create, read, write, close, seek), networked filesystem.
- **Security**: secure system, password salting, encryption, worms, access control list (ACL), security model.
- **Distributed system:** parallel architecture, message passing, RPC, NFS.

PREREQUISITES

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REFERENCES

1. G Andrew S. Tanembaum, “Modern Operating Systems”, Third Edition
2. William-stallings, “Operating Systems: Internals and design principles”, 6th-edition, Prentice-Hall

SEMESTER 4

	Course	**:**	**System Design and Engineering**
	Course ID	:	**EC 184401**
	Credit	:	2
	Semester	:	4

COURSE DESCRIPTION

In this course, students will learn how to analyze problems in a system, and to design and engineer said system. Topics include the history and development of system design, including System Context Diagram, System Flow, System Specification, System Data Dictionary, Unified Modeling Language, the steps for creating a system, and system architecture design.

EXPECTED LEARNING OUTCOME

- Trying to the fullest to achieve perfect results. (S11)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Theoretical concepts and techniques for the implementation of advanced computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Devices, Embedded Systems and Robotics. (P3)
- Ability to examine the implications of developing or implementing the science of technology that concerns and implements the value of humanities according to their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art

criticisms (KU3)

- Ability to implement information and communication technologies in the context of execution of activity (KU12)
- Ability to find the source of engineering problems in modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security through the process of investigation, analysis, interpretation of data and information based on engineering principles (KK5)
- Ability to conduct research that includes identification, formulation and analysis of engineering problems on modern computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK6)

COURSE OBJECTIVES

- Students are able to recognize and explain the process of system analysis
- Students are able to explain the technique of system design.
- Students are able to describe the steps of creating a system.
- Students are able to solve system problems with Unified Modeling Language
- Students are able to select and design a network-based system

TOPICS

- **System design history and development:** System Context Diagram, System Flow, System Specification, System Data Dictionary, and Unified Modeling Language
- **System creation steps**: system creation methods, requirement analysis, system design and problem solving with UML
- **System architecture design**: Technology and network selection

PREREQUISITES

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REFERENCES

1. Mike O'Docherty, Object-Oriented Analysis and Design: Understanding System Development with UML 2.0, John Wiley & Sons

2. Roger S. Pressman, Software Engineering: A Practitioner's Approach, 5th ed, McGrawHill

			Series for Engineering
	Course ID	:	**EC 184402**
	Credit	:	3
	Semester	:	4

COURSE DESCRIPTION

In this course, students will learn about solving differential equations using certain methods and using series. Topics include 1st order regular differential equations, 2nd order regular differential equations, differential equation system, solving differential equations using series, high-order differential equations, and application of differential equations in engineering.

EXPECTED LEARNING OUTCOME

- Uphold humanistic values in carrying out duties based on religion, morals, and ethics (S2)
- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and

technology that is aware of and applies the value of humanities in accordance with their areas of expertise (KU1)

- Ability to demonstrate independent, quality, and measurable performance (KU2)
- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

COURSE OBJECTIVES

- Students are able to explain the basic concepts of differential equations.
- Students are able to explain and apply the concept of solving first-order differential equations using variable separation method, exact differential equation model, and linear differential equation model (Bernoulli Equation).
- Students are able to analyze the existence and uniqueness of solutions on first order differential equations.
- Students are able to explain and apply the concept of solving homogeneous two-order differential equations using constant coefficients, and their application to engineering.
- Students are able to explain and apply the concept of solving non-homogeneous second-order differential equations using undetermined coefficient method, parameter variation method, and its application in engineering field.
- Students are able to explain and apply the concept of solving differential equation systems.
- Students are able to explain and apply the series concept for solving differential equations.

TOPICS

- **Differential equation concept**: definition, directional fields, graphic solution
- **First-order equations**: linear equations, variable separation, exact equations, Bernoulli equations, subsitution, validity interval, first-order equation modeling, and equilibrium solution.
- **Second-order equations**: basic concepts, homogenous second-

order equation solving with constant coefficient, order reduction, fundamental sets in solutions, Wronskian, non-homogenous second-order equation solving with undetermined coefficient method, parameter variation method, case study of applications in engineering.

- **Differential equation systems**: basic concepts, system solutions, phase plane, real and complex eigenvalues, twin eigenvalues, nonhomogeneous systems, equation solving with Laplace.
- **Equation solving with series**: power series, Taylor series, solving with series, Euler equations.
- **Higher-order equations**: basic concepts, homogenous linear equations, undetermined coefficients, parameter variations, solving with Laplace.

PREREQUISITES

- Mathematics I
- Mathematics II
- Physics I
- Physics II
- Linear Algebra & Discrete Mathematics

REFERENCES

1. Kreyszig, Erwin. "Advanced Engineering Mathematics, 9th Edition", John Wiley & Sons, Inc, 2006.
2. Robinson, James C, “An Itroduction to Ordinary Differential Equation”, Cambridge University Press, 2004.
3. Jeffrey, Alan. “Advanced Engineering Mathematics”, Harcourt Academic Press, London, 2002.
4. Paul Dawkins. “Differential Equations”. Lamar University

	System		
	Course ID	:	**EC 184403**
	Credit	:	3
	Semester	:	4

COURSE DESCRIPTION

In this course, students will learn about the concept of database management system (DBMS) and its components. In addition, it provides information on the latest developments of DBMS such as distributed databases, mobile databases, spatial databases, fuzzy databases, stream database, semi-structured databases and distributed multimedia databases, and database roles in data warehouses and data mining.

EXPECTED LEARNING OUTCOME

- Internalizing the spirit of independence, struggle, and entrepreneurship (S10)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and techniques for the implementation of advanced computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Devices, Embedded Systems and Robotics. (P3)
- Principles and techniques for designing computer systems and networks, encompassing hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P4)
- Ability to demonstrate independent, quality, and measurable performance (KU2)
- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis (KU5)
- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and

networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK4)

COURSE OBJECTIVES

- Students have the ability to explain the differences between the file system and the DBMS
- Students have the ability to explain the components of the DBMS.
- Students have the ability to use SQL commands for defining and processing data.
- Students have the ability to form a database through normalization process
- Students have the ability to form a database from E-R diagrams.
- Students have the ability to explain current applications of DBMS such as distributed databases, mobile databases, spatial databases, fuzzy databases, stream databases, semi-structured databases and distributed multimedia databases, and database roles in data warehouses and data mining.

TOPICS

6. File system and DBMS, database model (hierarchy, network, and relational), E-R diagrams, relational queries, integrity and security, relational database design (dependency, integrity, normal form, normalization, and decomposition).
7. DBMS components, storage, file structure, organization, and indexing. Query processing, query optimization, transaction management, concurrent control, and system recovery.
8. Distributed databases, mobile databases, spatial databases, fuzzy databases, stream database, semi-structured databases, and distributed multimedia databases, as well as database roles in data warehouses

and data mining.
PREREQUISITES
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REFERENCES
1. Silberschatz, Korth, Sudarshan, "Database System Concept", Fifth Edition, McGraw-Hill, 2006. 2. Raghu Ramakrisnan, "Database Management Systems ", Second Edition, McGraw-Hill, 2006.

	Course ID	:	**EC 184404**
	Credit	:	3
	Semester	:	4

COURSE DESCRIPTION

In this course, students will learn about signal representation and discrete systems in the time and frequency areas, the process of sampling and reconstruction of signals, planning digital filters and applying discrete systems on digital electronics equipments.

EXPECTED LEARNING OUTCOME

- Internalizing the spirit of independence, struggle, and entrepreneurship (S10)
- Trying to the fullest to achieve perfect results. (S11)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to examine the implications of developing or implementing the science of technology that concerns and implements the value of humanities according to their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticisms (KU3)
- Ability to make decisions appropriately in the context of problem

solving in the area of expertise, based on the results of information and data analysis (KU5)

- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)
- Ability to find the source of engineering problems in modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security through the process of investigation, analysis, interpretation of data and information based on engineering principles (KK5)

COURSE OBJECTIVES

- Ability to represent signals and digital systems in time and frequency domain
- Ability to analyze and realize time-invariant linear digital system
- Ability to explain and analyze the process of sampling and reconstruction of the signal
- Ability to explain and apply z-Transformation for discrete signal and systems analysis
- Ability to explain, calculate, analyze and simulate FFT on discrete signals and systems
- Ability to plan and implement FIR and IIR digital filters

TOPICS

- Representation of discrete signals and systems in time and frequency areas: Digital signals and systems, digital systems and their properties, linear-time invariant system responses, Discrete Fourier Transform (DFT).
- Basic structure of digital systems: Direct shape I and II realization, cascade form, paralles form, transpose form
- Sampling process and signal reconstruction: Continuous signal sampling process, Nyquist theorem, Signal reconstruction, Up-sampling, Down-sampling

- Z-Transformation: Z-transformation, inverse Z-transformation, discrete system analyzer using z-transformation
- Fast Fourier Transform (FFT): Understanding and computing FFT, understanding and computing Inverse Fast Fourier Transform (IFFT), signal spectrum and system frequency response simulation using FFT.
- Digital filter planning: Selective frequency-based digital filter types (LPF, HPF, BPF & BSF)
- FIR (Finite Impulse Response) filter planning: windowing method
- IIR (Infinite Impulse Response) filter planning: bilinier transformation method, impulse response method, Z-match method

PREREQUISITES

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REFERENCES

3. Alan V. Oppenheim, Ronald W. Schafer & John R. Buck, "Discrete-Time Signal Processing," 2nd ed., Prentice Hall, 1999.
4. L.C. Ludeman, "Fundamentals of Digital Signal Processing", Harper & Row, 1986
5. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms, Applications, Prentice Hall, 1996
6. Paulo S.R. Diniz, Eduardo A.B. da Silva, & Sergio L. Netto, "Digital Signal Processing: System Analysis and Design," Cambridge University Press, 2002

	Course ID	:	**EC 184405**
	Credit	:	3
	Semester	:	4

COURSE DESCRIPTION

In this course, students will learn about digital circuit synthesis and analysis, both combinational and sequential.

EXPECTED LEARNING OUTCOME

- Internalizing the spirit of independence, struggle, and entrepreneurship (S10)
- Trying to the fullest to achieve perfect results. (S11)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to examine the implications of developing or implementing the science of technology that concerns and implements the value of humanities according to their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticisms (KU3)
- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information

and data analysis (KU5)

- Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics. (KK1)
- Ability to design modern computer systems, computer-based systems, and modern computer networks that include hardware and software and integration to solve problems in the field of current engineering. (KK2)

COURSE OBJECTIVES

- Students are able to explain how SSI digital circuit components work (AND OR, XOR, EQV) as well as MSI and LSI components.
- Students are able to declare digital circuits into digital functions and, vice-versa, implement digital functions into digital circuits using SSI, MSI, and LSI components.
- Students are able to manipulate digital functions using Boolean algebra to obtain simple or expanded forms (canonical) to obtain optimal combinational circuits.
- Students are able to explain how the memory components work (flip flop) and use them to analyze and design synchronous sequential circuits.

TOPICS

- Komponen pembentuk rangkaian digital SSI: Implementasi operasi logika AND, OR, XOR, EQV pada komponen SSI menggunakan teknologi CMOS (transistor type p dan n sebagai switch). Komponen serupa menggunakan teknologi TTL. Implementasi fungsi digital kombinasional menjadi rangkaian kombinasional menggunakan komponen SSI. Menyatakan fungsi digital dalam bentuk tabel kebenaran dan K-map.
- SSI digital circuit components: Implementation of AND, OR, XOR, EQV logic operations on SSI components using CMOS technology (p- & n-type transistor as switches). Similar components using TTL technology. Implementation of

combinational digital functions into combinational circuits using SSI components. Specifying the digital function in the form of truth tables and K-maps.

- Combinational Digital Functions/Series and Boolean Algebra: Simplification of combinational digital functions using Boolean and K-map algebra to derive a circuit with minimal SSI components.
- MSI and LSI components: Adder (H/A and F/A), Encoder, Decoder Multiplexer, Programmable device (Prom, FPLA). Use of canonical form to utilize decoder components, multiplexers and programmable devices in the implementation of combinational circuits.
- Memory Components (Flip flop) and Synchronized Sequential Series: Characteristics table and Excitation Table for SR, D, JK, T flipflops. Synchronous sequential circuit analysis. Synchronous sequential sequence synthesis.
- Hardware description language.

PREREQUISITES

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REFERENCES

1. Richard F. Tinder, “ENGINEERING DIGITAL DESIGN ", Academic Press - Elsevier, 2000
2. John F. Wakerly, “Digital Design: Principles and Practices”, Elsevier, 2014

	Course ID	:	**EC 184406**
	Credit	:	3
	Semester	:	4

COURSE DESCRIPTION

In this course, students will learn about the probability theory and its usefulness to analyze the probability of occurrence in various applications, as well as provide knowledge about the technique of sample data analysis to know the population characteristics. Topics include probability theory, random variables and their distribution, expectations, normal distribution, parameter estimation, and hypothesis testing.

EXPECTED LEARNING OUTCOME

- Uphold humanistic values in carrying out duties based on religion, morals, and ethics (S2)
- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and

technology that is aware of and applies the value of humanities in accordance with their areas of expertise (KU1)

- Ability to demonstrate independent, quality, and measurable performance (KU2)
- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)

COURSE OBJECTIVES

- Students are able to solve combinatorial problems.
- Students are able to explain Bayes's theorem concept, conditional probability and freedom of occurrence, and solve problems associated with it.
- Students are able to explain about kinds of discrete and continuous distribution, and solve problems associated with it.
- Students are able to explain the theory of expectations and the law of large numbers, and use them in analyzing various distributions.
- Students are able to explain the theory of estimation, Bayes estimator, and maximum likelihood estimator, and use it in solving problems associated with it.
- Students are able to perform hypothesis test and goodness of fit test.

TOPICS

- Probability theory: Probability interpretation, probability properties, finite state samples, combinatorials, multinomial coefficient, conditional probability, event independence, Bayes theorem.
- Random variables and their distribution: discrete distribution, continuous distribution, mass function / probability density, cumulative distribution function, marginal distribution, conditional distribution, multivariate distribution, random variable function, Markov chain.
- Expectations: Chebyshev's inequality, variance, standard

deviation, law of large numbers, median, covariance and correlation.

- Binomial distribution and Poisson's
- Normal distribution: Central limit theorem, gamma distribution, beta distribution, Poisson distribution, binomial distribution approach.
- Parameter estimation: estimation theory, Bayes estimator, maxmum likelihood estimator, confidence interval for parameters in normal distribution.
- Hypothesis test: Bayes' decision rule, t-test, goodness of fit-test, Kolmogorov-Smirnov goodness of fit test.

PREREQUISITES

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REFERENCES

1. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 3rd ed., Academic Press, 2004.
2. M. H. DeGroot, M. J. Schervish, "Probability and Statistics", 4th edition, Pearson Education Inc., 2012.
3. D. C. Montgomery, G. C. Runger, "Applied Statisctics and Probability for Engineers", 3rd edition, John Wiley and Sons Inc., 2002.
4. R. E. Walpole, R. H. Myers, S. L. Myers, K. Ye, "Probability and Statistics for Engineers and Scientists", 9th edition, Prentice Hall, 2011.
3.

SEMESTER 5

Mata Kuliah	**:**	**Jaringan Komputer dan Lab**
Kode Mata Kuliah	:	**EC 184501**
Kredit	:	4 SKS
Semester	:	5

DESKRIPSI MATA KULIAH
Pada mata kuliah ini, mahasiswa akan mempelajari tentang mekanisme komunikasi pada jaringan komputer, konsep internet, komponen-komponen dari internet, dan aplikasi yang menggunakan internet. Materi kuliah yang akan dipelajari oleh mahasiswa antara lain konsep dasar internet, packet forwarding, packet switching, reliable communication, congestion control, names, address, teknologi physical, link layer, konsep subnetting, interdomain routing, world wide web, dan DNS.
CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH
Menginternalisasi nilai, norma, dan etika akademik. (S8)
Menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri. (S9)
Menguasai konsep teoretis sains alam, matematika rekayasa, sains-rekayasa (engineering sciences), prinsip-prinsip rekayasa (engineering principles), dan perancangan rekayasa yang diperlukan untuk analisis dan perancangan sistem dan jaringan komputer yang mencakup perangkat keras dan piranti lunak yang diterapkan pada sistem tertanam, pengolahan sinyal digital, sistem komunikasi, komputasi multimedia dan keamanan informasi. (P1)
Mampu menerapkan matematika, sains, dan prinsip rekayasa (engineering principles) untuk menyelesaikan masalah rekayasa pada sistem dan jaringan komputer modern yang mencakup perangkat keras dan piranti lunak yang diterapkan pada sistem tertanam, pengolahan sinyal digital, sistem komunikasi, komputasi multimedia dan keamanan informasi. (KK3)
Mampu menerapkan bidang-bidang keilmuan yang berkaitan yaitu : Sistem dan rangkaian elekronika, algoritma komputer, oraganisasi dan arsitektur komputer, sistem digital, desain software, sistem dan rekayasa

proyek, dan sistem cerdas untuk menyelesaikan masalah rekayasa pada sistem dan jaringan komputer modern yang mencakup perangkat keras dan piranti lunak yang diterapkan pada sistem tertanam, pengolahan sinyal digital, sistem komunikasi, komputasi multimedia dan keamanan informasi. (KK4)
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 2. (KU1)
Mampu menunjukkan kinerja mandiri, bermutu, dan terukur. (KU2)
CAPAIAN PEMBELAJARAN MATA KULIAH
• Mahasiswa mampu menjelaskan konsep dasar internet, contoh aplikasinya, dan konsep layering pada desain internet. • Mahasiswa mampu menjelaskan konsep forwarding, packet switching, reliable communication, dan congestion control. • Mahasiswa mampu menjelaskan konsep names dan addresses. • Mahasiswa mampu menjelaskan teknologi yang digunakan pada physical dan link layer. • Mahasiswa mampu menjelaskan dan mengaplikasikan konsep subnetting. • Mahasiswa mampu menjelaskan dan mengaplikasikan konsep interdomain routing. • Mahasiswa mampu menjelaskan dan mengoperasikan aplikasi internet (Web dam DNS).
POKOK BAHASAN
• Konsep Dasar Internet: Pengenalan internet, sejarah internet, konsep dasar bagaimana internet bekerja, dan konsep layering. • Forwarding dan Packet Switching: Pengenalan packet switching, end-to-end delay, queueing model, konsep forwarding, rate guarantees, dan delay guarantees. • Reliable Communication dan Congestion Control: Stop & wait, sliding window, fragmentation, deteksi data error, TCP & UDP, dan konsep congestion control. • Names dan Addresses: ARP (Address Resolution Protocol), DHCP (Dynamic Host Configuration Protocol), DNS (Domain Name System), IPv4, IPv6, dan NAT (Network Address Translation). • Teknologi Physical dan Link Layer: Ethernet, CSMA/CD,

MAC, Wireless, CSMA/CA, dan RTS/CTS.

- Konsep Subnetting dan Interdomain Routing: Konsep Subnetting, Spanning Tree, RIP, OSPF, dan Multicast.
- Web dan DNS: Konsep dasar protokol HTTP (Web Server), protokol DNS Server, dan CDN (Content Distribution Network).

PRASYARAT

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PUSTAKA

1. Jim Kurose dan Keith Ross, " Computer Networking: A Top-Down Approach, 6th edition", Pearson Education, 2012.
2. Andrew S. Tanenbaum dan David J. Wetherall, "Computer Networks (5th Edition) ", Prentice Hall, 2010
3. Kevin R. Fall dan W. Richard Stevens, “TCP/IP Illustrated, Volume 1: The Protocols (2nd Edition)”, Addison-Wesley Professional, 2011
4. Larry L. Peterson dan Bruce S. Davie , “Computer Networks, Fifth Edition: A Systems Approach (The Morgan Kaufmann Series in Networking)”, Morgan Kaufmann, 2011

	Course	**:**	**Computer System Architecture and Organization**
	Course ID	:	**EC 184502**
	Credit	:	3
	Semester	:	5

COURSE DESCRIPTION

In this course, students will learn about how hardware and software components is engineered and organized to become a system working as a computer.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Principles and techniques for designing computer systems and networks, encompassing hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P4)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)

- Ability to demonstrate independent, quality, and measurable performance (KU2)
- Ability to design modern computer systems, computer-based systems, and modern computer networks that include hardware and software and integration to solve problems in the field of current engineering. (KK2)
- Ability to design modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, as per applicable technical, safety and health standards with respect to performance and reliability aspects, application and sustainability, ease and convenience of use and taking into account economic, health and safety, public, cultural, social and environmental factors. (KK8)

COURSE OBJECTIVES

- Students are able to explain that the hardware components of the CPU, I/O units, Memory units and Instruction Set are designed in a single computer system to execute the program.
- Students are able to explain that the CPU can be implemented as either hardwired or microprogrammed.
- Students are able to explain the various I/O processes according to the characteristics of each I/O unit.
- Students are able to explain engineering techniques (cache memory, virtual memory) that can be applied to system memory.

TOPICS

9. The concept of transfer registers and hardwired control. A basic computer with a simple specification is introduced as composed of the CPU (some functional and ALU registers), memory and instruction set. Each instruction is described on some transfer registers (micro operation) which can be accommodated by hardware so that it can be derived by the required (hardwired) control unit.
10. Programming: Simple algorithms are implemented into programs for basic computers that have been designed using the chosen instruction set.
11. Microprogrammed Control: An implemented control unit is

reimplemented using microprogramming.

12. I/O process: Interfacing I/O units on the CPU (memory mapped I/O, isolated I/O) and I/O process control techniques (programmed control, interrupt, sync, asynchronous, DMA) according to the characteristics of the units.
13. Memory: Interfacing memory on the CPU, cache memory techniques, virtual memory techniques

PREREQUISITES

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REFERENCES

1. M. Mano, "Computer System Architecture ", Prentice Hall, 1993.
2. Malvino, Digital Computer Electronics. McGrawHill

Course	**:**	**Machine Learning**
Course ID	:	**EC 184503**
Credit	:	3
Semester	:	5

COURSE DESCRIPTION

In this course, students will learn about machine learning and its application in the real world. Topics include linear prediction, linear regression, non-linear regression, Bayesian learning, Gaussian process, Bayesian optimization, decision tree, random forests, gradient descent, importance sampling, neural network, and Markov chain Monte Carlo (MCMC).

EXPECTED LEARNING OUTCOME

COURSE OBJECTIVES

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)
- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis (KU5)
- Ability to take responsibility for the achievements of the group and to

supervise and evaluate the completion of work assigned to the workers under his / her responsibility. (KU7)

- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK4)
- Ability to conduct research that includes identification, formulation and analysis of engineering problems on modern computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK6)

TOPICS

- **Linear Prediction**: linear regression, non-linear regression, logistic regression, cross-validation, maximum likelihood, lasso, automatic variable selection.
- **Bayesian**: Bayes rule, Bayesian learning, graphical model, inference, Bayesian tree, Naïve bayes classifier, Bernoulli distribution, HMM.
- **Gaussian Process**: Gaussian process for non-linear regression, Bayesian optimization, Thomson sampling andbandits.
- **Tree**: decision tree, random forests.
- **Neural Network**: percepton, multi layer perceptron, gradient descent, back-propagation.
- **MCMC**: important sampling, Markov chain Monte Carlo.

PREREQUISITES

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REFERENCES

1. Kevin Patrick Murphy, “Machine Learning: a Probabilistic Perspective”, fourth edition (Sept 2013), MIT Press.
2. Chris Bishop, “Pattern Recognition and Machine Learning”, Springer 2006.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman. “The elements of statistical learning”, Springer 2001.

4. Larry Wasserman, “All of Statistics, Springer 2004.

5. David Mackay, “Information theory, inference and learning algorithms”, CUP 2003

6. Jim Albert, “Bayesian Computation with R”, Springer 2007.

7. Duda, Hart, Stork, “Pattern Classification (2nd ed.)”, Wiley 2001.

	Course	:	**Image and Video Processing**
	Course ID	:	**EC 184503**
	Credit	:	3
	Semester	:	5

COURSE DESCRIPTION

In this course, students will learn about digital images and video, from the process of acquisition, storage, compression, delivery, and processing such as repair, restoration, segmentation, description, representation, classification, recognition, and visualization of objects from digital images or video.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)
- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis (KU5)

- Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the workers under his / her responsibility. (KU7)
- Ability to apply mathematics, science, and engineering principles to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK3)
- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK4)

COURSE OBJECTIVES

- Students have the ability to explain digital image data acquisition techniques, methods, and storage techniques as well as digital image compression.
- Students have the ability to explain improvement techniques, restoration of digital image data and be able to mimic an example program implementing such techniques on a computer program.
- Students have the ability to demonstrate digital image processing techniques to solve simple problems.
- Students have the ability to analyze and design to solve problems involving image and video processing based on the techniques already studied.
- Students have the ability to combine image processing techniques to solve problems involving image processing.

TOPICS

1. Digital image concepts and acquisition techniques: Introduction to digital image and video processing, digital image and video acquisition techniques, color imagery: basic theory of color, color

model and transformation

2. Frequency domain of digital images: Discrete Fourier Transform, Wavelet & Multiresolution, and Mathematical Morphology.
3. Thresholding and Filtering: Global Thresholding, local and adaptive thresholding, basic binary image processing, digital image and video enhancement with linear & non-linear filters, Morphological filtering, Wavelet denoising
4. Image Restoration: digital image & video restoration with basic techniques, multi-channel, multi-frame and iterative techniques.
5. Segmentasi pada gambar digital: Deteksi sisi konvensional (meliputi gradien, hough, dan laplacian), Deteksi sisi berbasis teknik difusi edge-linking, Segmentasi citra berbasis area (region growing, split& merge), Segmentasi berbasis keliling (boundary), Segmentasi berbasis deformable model, Segmentasi berbasis neural network. Segmentation of digital images: Conventional side detection (including gradient, Hough, and Laplacian), edge-linking diffusion-based edge detection, area-based segmentation (region-wide, split & merge), boundary segmentation, deformable model-based segmentation, Segmentation based on neural network.
6. Image compression: Image compression with block truncation, multispectral technique, vector quantization, wavelet-based.
7. Video compression: Basic concepts, video coding techniques and H.261 standards, Wavelet-based image compression, spatio temporal subband-based image compression, object-based compression, MPEG-1 and MPEG-2 video standard, MPEG-4 and MPEG- 7.
8. Video segmentation: optical flow and coherent temporal-based segmentation.

PREREQUISITES

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REFERENCES

1. Alan C. Bovik, "Handbook of Image and Video Processing ", Academic Press, 2000
2. Rafael C. Gonzalez, "Digital Image Processing", 3rd Ed., Pearson Education, 2008

Course	**:**	**Microprocessor Systems and Microcontrollers**
Course ID	:	**EC 184505**
Credit	:	3
Semester	:	5

COURSE DESCRIPTION

In this course, students will learn about the microprocessor and its basic theories (Arithmetic Logic Unit, Register, and Control Signal), memory, input-output, Timer, interrupts, and cycles.

EXPECTED LEARNING OUTCOME

- Internalizing the spirit of independence, struggle, and entrepreneurship (S10)
- Trying to the fullest to achieve perfect results. (S11)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to examine the implications of developing or implementing the science of technology that concerns and implements the value of humanities according to their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art

criticisms (KU3)

- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis (KU5)
- Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics. (KK1)
- Ability to design modern computer systems, computer-based systems, and modern computer networks that include hardware and software and integration to solve problems in the field of current engineering. (KK2)

COURSE OBJECTIVES

- Understand the concepts of digital design
- Understand the concepts of the processor
- Understand the programming languages used in microprocessors
- Understand the single-cycle processor
- Understand the multi-cycles processor
- Understand the memory system and input-output

TOPICS

1. Logic gate combinations, structure models, sequential logic, finite state machine
2. Microprocessor structure, general description, architecture, memory organization, Arithmetic Logic Unit, Register, control signal, AVR microcontroller
3. Assembly language, machine language, programming, and addressing
4. Capability analysis of single-cycle processor
5. Capability analysis of multi-cycle, pipelined processor
6. Memory system (cache, virtual memory), Input-output memory mapping, bus system.
7.

PREREQUISITES

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REFERENCES
1. Steven F. Barrett, “Atmel AVR Microcontroller Primer: Programming and Interfacing, Second Edition (Synthesis Lectures on Digital Circuits and Systems)”, Morgan and Claypool, 2012 2. Muhammad Ali Mazidi, “The AVR microcontroller and Embedded systems: Using Assembly and C”, Mazidi and Naimi, 2011 3. Steven F. Barrett, “Arduino Microcontroller: Processing for Everyone! Second Edition (Synthesis Lectures on Digital Circuits and Systems)”, Morgan and Claypool, 2012

SEMESTER 6

	Course	:	**Network and System Programming**
	Course ID	:	**EC 184602**
	Credit	:	3
	Semester	:	6

COURSE DESCRIPTION

In this course, students will learn programming at the system level. Students will be introduced to the programming system and its environment. Topics include file systems, processes, threads, POSIX, IPC, pipes, and sockets.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)
- Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the

workers under his / her responsibility. (KU7)

- Ability to conduct self-evaluation process to workgroups under his/her responsibility, and able to manage independent learning. (KU8)
- Ability to design modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, as per applicable technical, safety and health standards with respect to performance and reliability aspects, application and sustainability, ease and convenience of use and taking into account economic, health and safety, public, cultural, social and environmental factors. (KK8)
- Ability to select resources and utilize design tools and engineering analysis based on appropriate information, communications and computing technology to perform engineering activities on modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK9)

COURSE OBJECTIVES

- Students are able to understand and apply the basics of programming of file systems and processes.
- Students are able to understand and apply the concept of thread management and POSIX on system programming.
- Students are able to understand the concept of IPC and pipes on system programming.
- Students are able to understand and apply socket programming on system programming.

TOPICS

Introduction of file system programming, processes, threads, POSIX, IPC, pipes, and sockets.

PREREQUISITES
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REFERENCES
1. Adam Hoover, “System Programming with C and Unix”, Addison-Wesley, 2010 2. Bruce Molay. Understanding UNIX/LINUX Programming: A Guide to Theory and Practice, Prentice-Hall, Inc., Upper Saddle River, NJ, USA, 2002

Course	**:**	**Embedded Systems and Lab**
Course ID	:	**EC 184603**
Credit	:	3
Semester	:	6

COURSE DESCRIPTION

In this course, students will learn the concept and design of embedded systems. Students are introduced to the peripherals (input, output and processor systems) associated with embedded systems. Topics include the introduction of the concept of embedded systems, peripherals of embedded systems and its features, SoC design techniques, and embedded programming languages.

EXPECTED LEARNING OUTCOME

- Internalizing the spirit of independence, struggle, and entrepreneurship (S10)
- Trying to the fullest to achieve perfect results. (S11)
- Theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P1)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information

and data analysis (KU5)

- Ability to conduct research that includes identification, formulation and analysis of engineering problems on modern computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK6)
- Ability to design modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, as per applicable technical, safety and health standards with respect to performance and reliability aspects, application and sustainability, ease and convenience of use and taking into account economic, health and safety, public, cultural, social and environmental factors. (KK8)
- Ability to select resources and utilize design tools and engineering analysis based on appropriate information, communications and computing technology to perform engineering activities on modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK9)

COURSE OBJECTIVES

- Students are able to understand the embedded system concepts, embedded system devices, and SoC designing and programming.
- Students are able to implement and integrate various peripherals in integrated systems as well as embedded system programming.
- Students are able to apply the concept of digital design in a System on Chip.

TOPICS

Introduction of embedded devices, its design and integration in an integrated system. Programming of embedded device and system programming in an SoC.

PREREQUISITES
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REFERENCES

3. Steve Heath, “Embedded System Design”, The MIT Press Cambridge, Massachusetts London, England, 2001
4. Marilyn Wolf, “Computers as Components, Fourth Edition: Principles of Embedded Computing System Design (The Morgan Kaufmann Series in Computer Architecture and Design)”, Todd Green, 2012
5. Ronald Sass, “Embedded Systems Design with Platform FPGAs: Principles and Practices”, Elsevier, 2010

	Course	:	**Computer Vision**
	Course ID	:	**EC 184604**
	Credit	:	3
	Semester	:	6

COURSE DESCRIPTION

In this course, students will learn about computer vision concepts, and usage of stereo camera and its problems.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)
- Ability to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis (KU5)
- Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the workers under his / her responsibility. (KU7)

- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (KK4)
- Ability to conduct research that includes identification, formulation and analysis of engineering problems on modern computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK6)

COURSE OBJECTIVES

- Students are able to explain computer vision concepts
- Students are able to implement computer vision algorithms.

TOPICS

1. Computer vision basics
2. Image models
3. Stereo view
4. Plural view concept
5. Epipolar geometry
6. 3D reconstruction

PREREQUISITES

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REFERENCES

1. Forysh, Ponce, ”Computer Vision Modern Approach “, Prentice Hall 2003
2. Nikos Paragios, Yunmey Chen, ”Handbook Of Mathematical Model in Computer Vision”, Springer,2006
3. Steven Harrington, ”Computer Graphics A Programming Approach Second Edition”, McGraw-Hill International Editions1987.
4. Max K. Agoston, MA, MS, PhD, “Computer Graphics and Geometric Modeling Implementation and Algorithms”, Springer-

Verlag London 2005

SEMESTER 7

Course	**:**	**Wireless Sensor Network and IoT**
Course ID	:	**EC 184603**
Credit	:	3
Semester	:	7

COURSE DESCRIPTION

In this course, students will learn about the Internet of Things, one of the latest technology in the field of computer networks. IoT concerns itself with objects that has the ability to communicate over a network without requiring human-to-human or human-to-computer interaction. IoT can be composed of several node sensors equipped with data processing, memory, battery and wireless communication equipment (Wireless Sensor Node/WSN). The node sensors send data to the sinks, which in turn send data to the server or cloud ctorage over the Internet. Among the systems that implement IoT are agriculture, traffic, health, and some other fields.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and

networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)

- Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the workers under his / her responsibility. (KU7)
- Ability to conduct self-evaluation process to workgroups under his/her responsibility, and able to manage independent learning. (KU8)
- Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics. (KK1)
- Ability to formulate solutions to engineering problems in modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, taking into account economic, health and safety, cultural, social and environmental factors, (KK7)

COURSE OBJECTIVES

- Mahasiswa mampu memahami paradigma pemrograman selain konsep pemrograman sekuensial dan berbasis objek.
- Students are able to understand other programming paradigms outside of sequential and object-based programming.
- Students are able to apply functional programming paradigm by using the Scheme programming language.
- Students are able to understand and apply the IOT concept to agriculture, transportation, health and some other fields.

TOPICS

IoT-supporting components, wireless sensor networks, inter-sensor communications protocol, sensor-to-cloud storage communications protocol, WSN implementation with microcontroller & single-board computer.

PREREQUISITES

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REFERENCES

1. Samuel Greengard, “The Internet of Things”, MIT Press 2015.
2. H. Karl and A. Willig, Protocols and Architectures for Wireless Sensor Networks”, Wiley Publishers, 2005.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", C. Raman, (CRC Press)
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", (Universities Press)

Course	**:**	**Computer System Security**
Course ID	:	EC 184702
Credit	:	3
Semester	:	7

COURSE DESCRIPTION

In this course, students will learn about computer system security and its problems. Students will be exposed to basic security concepts on networks, software, infrastructure, and viruses. Topics include reviewing computer networking materials and operating systems, software security, passwords, authentication, privacy, data integrity, anonymity, security on network services, infrastructure security, firewalls, viruses, intrusion detection and network attacks.

EXPECTED LEARNING OUTCOME

- Demonstrated responsibility towards the work in the field of expertise independently (S9)
- Working together to be able to take full advantage of each others' potential. (S12)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P2)
- The latest and up-to-date communication techniques and technological developments in the field of computer systems and networks covering hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P6)
- Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the workers under his / her responsibility. (KU7)
- Ability to document, store, secure, and rediscover data to ensure

validity and prevent plagiarism (KU9)

- Ability to analyze problems in the field of engineering and seek solutions by utilizing modern computer systems and computer systems technology, including Cloud Computing, Wireless Sensor Network, Internet of Things, Wearable Device, Embedded System and Robotics. (KK1)
- Ability to formulate solutions to engineering problems in modern computer systems and networks that include hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security, taking into account economic, health and safety, cultural, social and environmental factors, (KK7)

COURSE OBJECTIVES

- Students are able to explain and understand the basics of security its policies, basic security principles, and cryptography basics.
- Students are able to explain and apply the concept of access control and system file security.
- Students are able to explain and apply the concept of security to software, input handling from programs, race conditions, and memory exploitations.
- Students are able to explain and understand malicious software, viruses, worms, rootkits, and botnets.
- Students are able to explain and implement the concepts of network threat, network security, and intrusion detection.
- Students are able to explain and apply the concept of SSL, secure email, and PKI.
- Students are able to explain and apply the concept of web security and its prevention methods.
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TOPICS

- Basic concepts and definitions of information protection
- Threat identification and protection
- Computer network security
- Wireless network security
- Software security
- Security infrastructure, firewall, intrusion detection and network attacks
- Hacking ethics

- Encryption methods, authentication, data integrity, and anonymity
- Cryptography and ciphers
- Asynchronous encryption rules
- Electronic signature.

PREREQUISITES

1. Numerical Methods
2. Internet Network Engineering
3. Distributed Systems

REFERENCES

1. William Stallings dan Lawrie Brown, "Computer Security: Principles and Practice, 2/E", Prentice Hall, 2012 2.
2. Georg Hager dan Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers (Chapman & Hall/CRC Computational Science)", CRC Press, 2010.

SUPPORTING REFERENCES

Selected journals from IEEE and ACM

SEMESTER 8

	Course	**:**	**Electrical Technology Competency**
	Course ID	:	EC184802
	Credit	:	3
	Semester	:	8

COURSE DESCRIPTION

In this course, students will study, simulate and implement techniques based on Electrical Measurement, Electrical Circuits, Telecommunications System Basics and Electronic Circuits in laboratory activities based on related subjects.

EXPECTED LEARNING OUTCOME

- Trying to the fullest to achieve perfect results. (S11)
- Working together to be able to take full advantage of each others' potential. (S12)
- Mastered the theoretical concepts of natural sciences, engineering mathematics, engineering sciences, engineering principles, and engineering design required for the analysis and design of systems and computer networks that encompasses hardware and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (P01)
- Theoretical concepts and implementations of related scientific fields, among others electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, systems and project engineering, and intelligent systems for solving engineering problems in modern computer systems and networks which includes hardware and software applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security (P02)
- Ability to apply the related scientific fields of electronic systems and circuits, computer algorithms, computer architecture and organization, digital systems, software design, project engineering and systems, and intelligent systems to solve engineering problems in modern computer systems and networks that encompasses hardware

and software as applied to embedded systems, digital signal processing, communication systems, multimedia computing and information security. (KK4)

- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that is aware of and applies the value of humanities in accordance with their areas of expertise. (KU1)
- Ability to demonstrate independent, quality, and measurable performance. (KU2)
- Ability to take responsibility for the achievements of the group and to supervise and evaluate the completion of work assigned to the workers under his / her responsibility. (KU07)
- Ability to conduct self-evaluation process to workgroups under his/her responsibility, and able to manage independent learning. (KU08)
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COURSE OBJECTIVES

- Ability to properly use measurement tools
- Ability to measure electronic parameters using the proper measurement tools.
- Ability to simulate and build electrical circuits and measure relevant parameters as taught in concepts of Electrical Circuits.
- Ability to simulate and build electronical circuits and measure relevant parameters as taught in concepts of Electronical Circuits.
- Ability to simulate telecommunications system basics and measure relevant parameters as taught in concepts of Telecommunications System Basics.

TOPICS

- Analog and digital avometer usage
- Oscilloscope usage
- Electical current measurement
- Electrical voltage measurement
- Electrical power measurement
- Simulate and build electrical circuits of varying complexity (R-L-C)
- Simulate and build electronical circuits of varying complexity (transistor circuit)

- Simulate and build a simple communications system design
- Measure and validate the results

PREREQUISITES

- Electrical Circuits, Telecommunications System Basics, Introduction to Electrical Engineering, Electronical Circuits

REFERENCES

4. Electrical Measurement Experiment Module
5. Electrical Circuits Experiment Module
6. Electronical Circuits Experiment Module
7. Telecommunications System Basics Experiment Module