CURRICULUM 2018-2023
BACHELOR PROGRAM
DEPARTMENT OF MATHEMATICS

FACULTY OF MATHEMATICS, COMPUTING, AND DATA SCIENCE
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA

2017

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DEPARTMENT OF MATHEMATICS

Vision of Department of Mathematics

To be department with International reputation in mathematics and computation with its application. Supporting science and technology especially in industrial, energi, ocean, financial and information technology width environment concept.

Mission of Department of Mathematics

1. To carry out mathematics education based of informatics technology and communications to produce graduate with believe in god, international qualification, relative with job market need, respond to development of science and technology and have entrepreneur science.
2. Increase mathematics research quality and its applications in national and international level supporting science and technology especially in industrial, energy, ocean, financial and informatic technology with environmental concept.
3. To increase community service activity to spread mathematics and its application.
4. To develop network and synergy with higher education inside and foreign industrial, community and government in carryout Tri dharma higher education in mathematics and its application.
5. To increase competency of lecturer and staff to more creatively and professionally to carryout the tasks.

Vision of Bachelor Program

PSSM-ITS as a leading institution in mathematics undergraduate education program with international reputation especially in anlysis, algebra and computation to support and develop applied mathematics in industrial, ocean, financial and informatic technology wiyh environmental concept.

Mission of Bachelor Program

1. To carry out mathematics education based of informatics technology and communications to produce graduate with believe in god, international qualification, relative with job market need, respond to development of science and technology and have entrepreneur science.

2. Increase mathematics research quality and its applications in national and international level supporting science and technology especially in industrial, energy, ocean, financial and informatic technology with environmental concept.
3. To increase community service activity to spread mathematics and its application.
4. To develop network and synergy with higher education inside and foreign indrustial, community and government in carryout Tri dharma higher education in mathematics and its application.

Goal of Bachelor Program

To supply education and high quality research based on informatic and communication technology to produce mathematic graduates that:

1. respond to change and science development and technology,
2. have international quality with competency in analysis, algebra, applied mathematics, and computer science suit job market need,
3. able to help solve real problem, especially related to energy, transportation, environmental, ocean, financial, industrial and informatic technology, and
4. have entrepreneur science.

EXPECTED LEARNING OUTCOMES

DoMATH ITS

- ELO 1: [C2] Able to explain basic concepts of mathematics that includes the concept of a proof construction both logically and analytically, modeling and solving the simple problems, as well as the basic of computing.
- ELO 2: [C2] Able to demonstrate a moral, ethical and good personality in completing the task and respect to the cultural diversity, views, beliefs, and religions.
- ELO 3: [C3] Able to make use of the principles of long life learning to improve knowledge and current issues on mathematics.
- ELO 4: [C3] Able to plan entrepreneurship ideas and understand the technology-based entrepreneurship
- ELO 5: [C3] Able to solve problems based on theoretical concepts in at least one field of mathematics: analysis and algebra, modeling and system optimization, and computing science.
- ELO 6: [C4] Able to illustrate the framework of mathematical thinking in particular areas such as analysis, algebra, modeling, system optimization and computing science to solve real problems, mainly in the areas of environment, marine, energy and information technology.
- ELO 7: [C5] Able to explain ideas and knowledge in mathematics and other fields to the society, in similar professional organizations or others.
- ELO 8: [C5] Able to choose decisions and alternative solutions using data and information analysis based on an attitude of leadership, creativity and have high integrity in completing work individually or in a team

Detail of Learning Outcomes of Bachelor Program

Attitudes	
1.1	The students are cautious to one God and able to demonstrate a religious attitudes
1.2	The students uphold the humanity values while doing the task based on religion, morals, and ethics
1.3	The students contribute to the quality improvements of society, nation, state life, and civilization progress based on Pancasila
1.4	The students play a role as a citizen and love the homeland, have nationalism and responsibility to the state and nation
1.5	The students respect the cultural, views, religions, and beliefs diversity, as well as the other original opinions or inventions
1.6	The students work together and have social sensitivities and concern for society and environment
1.7	The students obey the law and discipline in social life and state
1.8	The students internalize academic values, norms, and ethics
1.9	The students demonstrate a responsible attitudes towards the works in their expertise
1.10	The students internalize the independence, struggle, and entrepreneurship spirits
1.11	The students strive to achieve the perfect results
1.12	The students work together to take full advantages from the owned potentials

General Skills	
2.1	The students are able to apply logical, critical, systematic, and innovative thinking in development or implementation of science and technology that cares and implements humanity values, appropriate to their expertise
2.2	The students are able to demonstrate independent, quality, and measurable performances
2.3	The students are able to examine the implications of the science and technology development or implementation, with concern and implement the humanity values in accordance with their expertise, based on rules, ordinances and scientific ethics in order to produce solutions, ideas, designs or art criticisms
2.4	The students are able to develop a scientific description from the studies in the form of final project, and upload it on the college website
2.5	The students are able to make decisions appropriately in the area of their expertise, based on the results of analysis information and data
2.6	The students are able to maintain and develop a network with mentors and colleagues, inside and outside the institution
2.7	The students are able to take responsibility for the achievements of teamwork, supervise and evaluate the completions of work assigned to the worker under their responsibility
2.8	The students are able to evaluate the group under their responsibility, and manage learnings independently
2.9	The students are able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism
2.10	The students are able to develop themselves and compete in national and international level
2.11	The students are able to implement the principles of sustainability to develop knowledge
2.12	The students are able to implement information and communication technologies in the context of implementation of their work
2.13	The students are able to apply entrepreneurship concepts and understand technology-based entrepreneurship

Knowledge	
3.1	The students understand the basic concepts of mathematics that include the logical or analytical proof construction concepts, modeling, simple problem solving, and basic computations.
3.2	The students understand one of mathematical theoretical concepts, those are analysis, algebra, modeling, system optimization and computer science, and apply them to analyze, design and evaluate problem solving

Special Skills	
4.1	The students are able to apply the mathematical thinking frameworks especially in the field of analysis, algebra, modeling, system optimization and computer science to solve real problems in the field of environment and settlement, marine, energy and information technology
4.2	The students are able to develop mathematical thinking, beginning with procedural or computational understanding to a broad understanding including exploration, logical reasoning, generalization, abstraction, and formal proof
4.3	The students are able to observe, recognize, formulate and solve problems through a mathematical approaches, with or without the help of software
4.4	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models, review their accuracy and interpret them
4.5	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6	The students are able to adapt or develop themselves, both in the field of mathematics and other relevant fields
4.7	The students are able to create employment according to their expertise

Details of Learning Outcomes of Bachelor Program

Code	Details of Learning Outcomes
1.1.1	The students are cautious to one God and able to demonstrate a religious attitudes
1.2.1	The students uphold the humanity values while doing the task based on religion, morals, and ethics
1.3.1	The students contribute to the quality improvements of society, nation, state life, and civilization progress based on Pancasila
1.4.1	The students play a role as a citizen and love the homeland, have nationalism and responsibility to the state and nation
1.5.1	The students respect the culturals, views, religions, and beliefs diversity, as well as the other original opinions or inventions
1.6.1	The students work together and have social sensitivities and concern for society and environment
1.7.1	The students obey the law and discipline in social life and state
1.8.1	The students internalize academic values, norms, and ethics
1.9.1	The students demonstrate a responsible attitudes towards the works in their expertise
1.10.1	The students internalize the independence, struggle, and entrepreneurship spirits
1.11.1	The students strive to achieve the perfect results
1.12.1	The students work together to take full advantages from the owned potentials
2.1.1	The students are able to apply logical, critical, systematic, and innovative thinking in development or implementation of science and technology that cares and implements humanity values, appropriate to their expertise
2.2.1	The students are able to demonstrate independent, quality, and measurable performances
2.3.1	The students are able to examine the implications of the science and technology development or implementation, with concern and implement the humanity values in accordance with their expertise, based on rules, ordinances and scientific ethics in order to produce solutions, ideas, designs or art criticisms
2.4.1	The students are able to develop a scientific descriptions from the studies in the form of final project, and upload it on the college website

2.5.1	The students are able to make decisions appropriately in the area of their expertise, based on the results of analysis information and data
2.6.1	The students are able to maintain and develop a network with mentors and colleagues, inside and outside the institution
2.7.1	The students are able to take responsibility for the achievements of teamwork, supervise and evaluate the completions of work assigned to the worker under their responsibility
2.8.1	The students are able to self evaluate about the group under their responsibility, and manage learnings independently
2.9.1	The students are able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism
2.10.1	The students are able to develop themselves and compete in national and international level
2.11.1	The students are able to implement the principles of sustainability to develope knowledges
2.l2.1	The students are able to implement information and communication technologies in the context of implementation of their work
2.13.1	The students are able to apply entrepreneurship concepts and understand technology-based entrepreneurship
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.1	The students are able to understand the basic mathematical theories, among others, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenon through a mathematical model and solve it

4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approaches
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approaches with the help of software
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
4.6.2	The students are able to follow the developments of Science and Technology that support the work field
4.7.1	The students are able to apply mathematical abilities to create jobs

CPL Evaluation, and CPL Linkage with Study Materials (BK) and Courses

Attached file.

HUMAN RESOURCES

Lecturers in Analysis and Algebra RMK

Supporting Lecturer	Course Name
Dr. Subiono, M.Si. Dian Winda, M.Si. Soleha, M.Si. Drs. Komar Baihaqi, M.Si.	Elementary Linear Algebra
	Algebra I
	Algebra II
	Linear Algebra
Dr. Mahmud Yunus, M.Si.	Mathematical Logic
	Topics in Analysis
	Fourier and Wavelet Transformation
Drs. Sentot Didik Surjanto, M.Si.	Complex Variable
Drs. Suhud Wahyudi, M.Si.	Vector Calculus
Drs. Sadjidon, M.Si.	Analysis II
Drs. IGN Rai Usadha, M.Si.	Analytic Geometry
	Number Theory
Drs. Iis Herisman, M.Si. Wahyu F. Doctorina, M.Si.	Geometry
	Differential Geometry
Drs. Mohammad Setijo W., M.Si.	Combinatorial Analysis
Dr. Darmaji, S.Si., M.T. Dra. Rinurwati, M.Si.	Introduction to Graph Theory
Sunarsini, S.Si, M.Si. Dra. Rinurwati, M.Si.	Analysis I
	Theory of Measurable and Integral
Dr. Dieky Adzkiya, S.Si, M.Si. Drs. Komar Baihaqi, M.Si.	Topics in Algebra

Lecturers in Applied Mathematics RMK

Supporting Lecturer	Course Name
Drs. Suharmadi Sanjaya, M.Phil.	Topics in Modeling, System, and Simulation
Dra. Farida Agustini Widjajati, MS.	Quality Control
Dr. Hariyanto, M.Si.	Partial Differential Equation
	Mathematical Modeling
	Dynamical System
	Optimization System
Dra. Sri Suprapti Hartatiati, M.Si.	Mathematical Methods
Dr. Chairul Imron, M.I.Komp. Prof. Basuki Widodo, M.Si.	Mathematical Writing
	Numerical Differential Equations
	Introduction to Computational Fluid Dynamics
	Numerical Partial Differential Equations
Dr. Didik Khusnul Arif, S.Si., M.Si.	Mathematical System
Dr. Drs. Soehardjoepri, M.Si.	Probability Theory
Drs. Suhud Wahyudi, M.Si.	Multivariable Calculus
Prof. Dr. Erna Apriliani, M.Si.	Optimum Estimation
Dr. Mardlijah, M.T.	Introduction to Dynamic Optimization
Dra. Laksmi Prita W., M.Si.	Mathematical Statistics
Dra. Nur Asiyah, M.Si.	Ordinary Differential Equation
Dra. Nuri Wahyuningsih, M.Kes.	Statistical Methods
	Experiment Design
	Forecasting Methods
Drs. Kamiran, M.Si.	Finite Difference
	Finite Element Methods
Drs. Lukman Hanafi, M.Sc.	Numerical Methods
Subchan, S.Si., M.Sc., Ph.D	Operations Research II
Valeriana Lukitosari, S.Si., M.T. Titik Mudjiati, M.Si.	Operations Research I
	Topics in Stochastic, Optimization, and Risks
	Introduction to Financial Mathematics

Endah Rokhmati MP, S.Si., M.T., Ph.D	Stochastic Process
	Introduction to Risk Analysis
Tahiyatul Asfihani, S.Si., M.Si.	Non Linear Differential Equation
Dosen Matematika	Practical Work

Lecturers in Computer Science RMK

Supporting Lecturer	Course Name
Drs. Soetrisno, M.I.Komp.	Discrete Mathematic
	Simulation
Prof. Dr. M. Isa Irawan, M.T.	Artificial Intelligence
	Artificial Neural Network
	Fuzzy Logic
	Decision Support Systems
Dr. Darmaji, S.Si., M.T.	Cryptography
Dr. Imam Mukhlash, S.Si., M.T. Drs. Bandung Arry S., M.I.Komp.	Data Mining
	Design and Analysis of Algorithm
	Software Engineering
Dr. Dwi Ratna Sulistyaningrum, M.T. Alvida Mustika R., M.Si. Drs. Daryono Budi Utomo, M.Si.	Algorithm and Programming
	Object Oriented Programming
	Digital Image Processing
	Topics in Computing
Dr. Budi Setiyono, M.T. Drs. Nurul Hidayat, M.I.Komp.	Mathematical Software
	Database Systems
	Development of Web and Mobile Application

FACILITIES AND INFRASTRUCTURE

Lecturer Rooms

Department of Mathematics has 24 lecturers rooms. From the work room of the lecturer lecturers rooms, there are 17 rooms occupied by 2 lecturers and there are 7 rooms occupied by 1 lecturer.

Lecturer Rooms	Room Number	Area (m^2)
One room for more than 4 lecturers		
One room for 3 or 4 lecturers		
One room for 2 lecturers	17	247,42
One room for 1 lecturer (not a structural official)	7	91,72
Total	24	339,14

Lecture and Research Rooms

To support the lecture and research process, Department of Mathematics has 8 classrooms, 5 laboratory rooms, 1 reading room and 1 final projret room. The rooms can accommodate from 20 students to 80 students.

Room Name	Room Number	Area (m^2)	Utilization (h/week)
U.101 Classroom	1	17,28	40
U.102 Laboratory Room	1	17,28	40
F.101 Classroom	1	73,00	40
F.102 Classroom	1	56,16	40
F.109 Classroom	1	79,04	40
F.111 Classroom	1	48,28	40
F.110 Classroom	1	39,05	40
T.101 Classroom	1	156,20	40
Computer Science Laboratory Room	1	20,64	40
Model and Simulation Laboratory Room	1	72,10	40

Operations Research and Data Processing Laboratory Room	1	58,59	40
Analysis and Algebra Laboratory Room	1	84,66	40
Computational Laboratory Room	1	85,49	40
Mathematics Library	1	107,12	40
Final Project Room	1	35,91	40

Mathematics Library

The facilities in Mathematics Library: there are various textbooks, accredited national journals, international journals, proceedings and undergraduate thesis.

Type	Number
Textbooks	2681
Accredited National Journal	4
International Journal	9
Proceeding	20
Undergraduate thesis / thesis	1067
Dissertation	0
Total	3781

Laboratory

As mentioned above in Department of Mathematics there are 5 laboratories. Each laboratory has air conditioning, LCD, projector screen and some PCs.

Labratory Name	Main Equipment Type	Number
Computer Science Laboratory	PC ACER AZ 5801i5 Intel Core i5, DDR 4GB, HDD 1 TB, Wifi	15
	LCD Projector	1
	Projector Screen	1
Computational Laboratory	PC ACER AZ 5801i5 Intel Core i5, DDR 4GB, HDD 1 TB, Wifi	28
	LCD Projector	1
	Projector Screen	1

Operations Research and Data Processing Laboratory	PC Intel Core i3, DDR 2 GB, HDD 500	21
	LCD Projector	1
Model and Simulation Laboratory	PC ACER AZ 5801i5 Intel Core i5, DDR 4GB, HDD 1 TB, Wifi	17
	LCD Projector	1
	Projector Screen	1
Analysis and Algebra Laboratory	PC ACER AZ 5801i5 Intel Core i5, DDR 4GB, HDD 1 TB, Wifi	5

SYLLABUS

List of Bachelor Program Courses

Semester I			
Num.	**Course Code**	**Course Nama**	**Credit**
1	UG184914	English	2
2	KM184101	Mathematics 1	3
3	SF184101	Physics 1	4
4	SK184101	Chemistry 1	3
5	KM184102	Mathematical Logic	3
6	KM184103	Analytic Geometry	3
		Total	18

Semester II			
Num.	**Course Code**	**Course Nama**	**Credit**
1	UG18490X	Religion	2
2	UG184913	Civics	2
3	KM184201	Mathematics 2	3
4	SF184202	Physics 2	3
5	KM184202	Algorithm and Programming	4
6	KM184203	Elementary Linear Algebra	4
		Total	18

Semester III			
Num.	**Course Code**	**Course Nama**	**Credit**
1	UG184911	Pancasila	2
2	KM184301	Multivariable Calculus	4
3	KM184302	Operation Research I	3
4	KM184303	Object Oriented Programming	3
5	KM184304	Discrete Mathematics	3
6	KM184305	Statistical Methods	3
		Total	18

Semester IV			
Num.	**Course Code**	**Course Nama**	**Credit**
1	KM184401	Ordinary Differential Equation	3
2	KM184402	Algebra I	3
3	KM184403	Mathematical Software	3
4	KW184901	Probability Theory	3
5	KM184404	Numerical Methods	3
6	KM184405	Operation Research II	3
		Total	18

Semester V			
Num.	**Course Code**	**Course Nama**	**Credit**
1	KM184501	Analysis I	4
2	KM184502	Vector Calculus	2
3	KM184503	Partial Differential Equation	3
4	KM184504	Algebra II	3
5	KM184505	Mathematical Statistics	3
6	KM184506	Simulation	3
		Total	18

Semester VI			
Num.	**Course Code**	**Course Nama**	**Credit**
1	UG184912	Indonesian	2
2	KM184601	Analysis II	4
3	KM184602	Function of Complex Variables	3
4	KM184603	Mathematical Methods	3
5	KM184604	Mathematical System	4
6		Elective Courses	3
		Total	19

Semester VII			
Num.	**Course Code**	**Course Nama**	**Credit**
1	UG184915	Technopreneurship	2
2	KM184701	Mathematical Modeling	4
3	KM184702	Linear Algebra	3
4	KM184703	Mathematical Writing	2
5	KM184704	Combinatorial Analysis	3
6		Elective Courses	4
		Total	18

Semester VIII			
Num.	**Course Code**	**Course Nama**	**Credit**
1	KM184801	Final Project	6
2	UG184916	Technology Insight and Application	3
3		Elective Courses	8
		Total	17

List of Elective Courses

Semester VII			
RMK	**Course Code**	**Course Name**	**Kredit**
AA	KM184711	Number Theory	2
	KM184712	Geometry	2
	KM184713	Introduction to Graph Theory	2
MT	KM184714	Non-Linear Differential Equation	2
	KM184715	Finite Difference	2
	KM184716	Introduction to Dynamic Optimization	2
	KM184717	Practical Work	2
	KM184718	Introduction to Financial Mathematics	2
	KM184719	Stochastic Process	2
	KM184720	Quality Control	2
	KM184721	Numerical Differential Equations	2
	KM184731*	Pemodelan Matematika Sistem	3
IK	KM184722	Database Systems	2
	KM184723	Digital Image Processing	2
	KM184724	Artificial Intelligence	2
	KM184725	Data Mining	2
	KM184726	Data Structure	2

Semester VIII			
RMK	**Course Code**	**Course Name**	**Kredit**
AA	KM184811	Measure Theory and Integration	2
	KM184812	Topics in Analysis	2
	KM184813	Topics in Algebra	2
	KM184814	Fourier and Wavelet Transforms	2
	KM184815	Differential Geometry	2
MT	KM184816	Optimum Estimation	2
	KM184817	Introduction Dynamical System	2
	KM184818	Experiment Design	2
	KM184819	Topics in Modeling, System, and Simulation	2
	KM184820	Topics in Stochastic, Optimization, and Risks	2
	KM184821	Forecasting Methods	2
	KM184822	Finite Element Methods	2
	KM184823	Introduction to Risk Analysis	2
	KM184824	Introduction to Computational Fluid Dynamics	2
	KM184825	Numerical Partial Differential Equations	2
IK	KM184826	Design and Analysis of Algorithm	2
	KM184827	Software Engineering	2
	KM184828	Artificial Neural Network	2
	KM184829	Fuzzy Logic	2
	KM184830	Cryptography	2
	KM184831	Topics in Computing	2
	KM184832	Development of Web Application	2
	KM184833	Decision Support Systems	2
	KM184834	Database Technology	2

Detail of Courses

Course	**Course Name**	**: Mathematics 1**
	Course Code	**: KM184101**
	Credit	**: 3**
	Semester	**: 1**

Description of Course	
This course equips students of matrix concepts, determinants and systems of linear equations of mathematical thinking concepts in solving engineering problems, modeling and others in engineering related to differential applications. The lecture material is more emphasized on the technique of solving real problems that can be formulated into the function of one independent variable. The lecture material includes: matrices and determinants, solving systems of linear equations, real number systems (sequence, absolute value), complex numbers and algebraic operations, polar complex numbers, functions and limits, derivatives and applications and integral unassigned.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among others, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenon through a mathematical model and solve it

4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically

Course Learning Outcome

1. Able to understand the matrix and its determinants and its properties and able to solve the system of linear equations, determine the value of Eigen and vector Eigen.
2. Able to understand the meaning of the system of real numbers, the decimal shapes of real numbers, real coordinates, sequence properties, the definition of absolute value, inequality, coordinate fields, lines, spacing of two points, circles, parabola
3. Able to understand complex numbers and operations of complex number algebra, polar complex number and root withdrawal of complex number equations.
4. Able to understand and calculate function limits and determine the continuity of simple function functions.
5. Students can decrease (differentiate) explicit or implicit functions, according to chain rules
6. Able to draw graphics, use derivative tests to determine extreme points, up / down, and dolphins and apply them to function optimization problems, Taylor / Maclaurin series and able to calculate the limit of tact form.
7. Able to resolve integrals using fundamental theorems of calculus

Main Subject

1. The basic concept of matrix algebra, the nature of determinants of elementary row operations and systems of linear equations and Linear Transformations and Eigenvalues, Eigen vectors
2. The basic concepts of real-number systems: the notions of real-number systems, the decimal-shapes of real numbers, real coordinates, sequence properties, the definition of absolute values, inequalities, field coordinates, lines, spacing of two points, circles, parabolas
3. Sum, Multiplication, Results for, polar form complex number and its algebraic operations and root withdrawal of complex number equations.
4. Concepts of function, limit: Domain, range, linear, quadratic and trigonometric functions, and transcendent, function graph, function limit and continuity
5. Differentials / derivatives: derived definitions, Rules of classification (for polynomial functions, trigonometric, trancendence), chain rules and implicit function derivatives.

6. Derivative Application: The corresponding rates, rising intervals, concentrations, graphic depictions of asymptotes and peaks, extreme values and application of optimization problems, L'hopital theorem and Taylor / Maclaurin series.
7. Indefinite integral: Derivative and anti-derivative, indefinite integral, Linal integral indeterminate, Intangible intuitive base formulas, Int uncertain with substitutionproblems, vector Eigen

Prerequisites

Reference

1. Tim Dosen Jurusan Matematika ITS, *Buku Ajar Kalkulus I* , Edisi ke-4 Jurusan Matematika ITS, 2012
2. Anton, H. dkk, *Calculus*, 10-th edition, John Wiley & Sons, New York, 2012

Supporting Reference

1. Kreyzig, E, *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore, 2011
2. Purcell, J, E, Rigdon, S., E., *Calculus*, 9-th edition, Prentice-Hall, New Jersey, 2006
3. James Stewart , *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada,2012

Course	**Course Name**	**: Mathematics 2**
	Course Code	**: KM184201**
	Credit	**: 3**
	Semester	**: 2**

Description of Course	
This course provides basic concepts of mathematical thinking (completion existence, logic flow / settlement procedure) to students in solving real problems and can solve engineering problems, modeling and others in engineering related to integral application. as well as the ability to follow advanced courses that require basic concepts of mathematics and analysis. The lecture materials include: The concept of integration techniques, certain Integral Concepts, improper integrals and their Applications, Polar coordinates and parametric equations and their applications of flat area and arc length, sequences and Unfinished series, power series, Taylor Series and Mac Laurin series.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them

4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically

Course Learning Outcome

1. Able to master the basic concept of integration techniques.
2. Able to complete a certain Integral.
3. Ability to apply certain integrals on the plane area, the volume of objects by disc method and ring method, center of mass, application of Guldin theorem, force and fluid pressure.
4. Able to understand the polar coordinate system and parametric equations, can draw the graph, apply to the Area of the plain and the length of the arc
5. Able to calculate the convergence of sequences, able to test the unmeasured series convergence and calculate the infinite series to converge, transform the function into the Taylor series or Mac Laurin series

Main Subject

1. **The concept of integration technique:** Partial Integral,: Integral fs rational (linear factors, quadratic factors), Integration of trigonometric functions, reduction form, Int with trigonometric substitution (root form).
2. **Certain Integral Concepts:** Certain broad and integral issues, Evaluation of a given Int: Fundamental Theory of Calculus (I), a particular Int with substitution, Functions expressed as certain integrals, Fundamental Theory of Calculus (II) and improper integral
3. **Certain integral applications:** Plane area, Volume of rotary objects (method of discs, rings), Fluid style and pressure, Work (Business), Dot (Mass center), emphasis and Guldin's Theorem
4. **Polar coordinates and parametric equations:** Functions and graphs in polar coord, Plain area and arc length in polar coord, Functions in parametric form, Area and length of arc parametric functions
5. **Unfinished sequence and sequence:** sequences , convergence sequence, Incomplete series, convergence test and generating number of incompatible to convergent series, notion of power series, Taylor series and MacLaurint series.

Prerequisites

Reference
1. Tim Dosen Jurusan Mathematics ITS, *Buku Ajar Kalkulus 2* , Edisi ke-4 Jurusan Mathematics ITS, 2012 2. Anton, H. dkk, *Calculus,* 10-th edition, John Wiley & Sons, New York, 2012
Supporting Reference
1. Kreyzig, E, *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore, 2011 2. Purcell, J, E, Rigdon, S., E., *Calculus*, 9-th edition, Prentice-Hall, New Jersey, 2006 3. James Stewart , *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada,2012

Course	**Course Name**	**: Mathematics**
	Course Code	**: KM184151**
	Credit	**: 3**
	Semester	**: 2**

Description of Course	
This course equips students of matrix concepts, deteminan and systems of linear equations of mathematical thinking concepts in solving engineering problems, modeling and others in engineering related to differential applications. The lecture material is more emphasized on the technique of solving real problems that can be formulated into the function of one independent variable. Subject matter includes: matrix and determinant, solving system of linear equation, Eigen value and vector Eigen, real number system (real number number), function and gafic, derivative and its application and integral and its application on calculation of plane area and volume of rotary object.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among others, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomena through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically

Course Learning Outcome

1. Able to understand the matrix and determinants and their properties and able to solve the system of linear equations, determine the value of Eigen and vector Eigen.
2. Able to understand the notion of the system of real numbers, the decimal shapes of real numbers, real coordinates, the nature of obedience, inequality,
3. Able to understand the function of polynomial and transcendent functions and able to draw a basic graph.
4. Able to define sine, cosines, tangents and apply trigonometric similarities in simplifying / resolving trigonometric equations.
5. Able to lower (differentiate) the explicit function, assigns chain rules, implicit function derivatives and is able to specify max / min values for polynomial functions.
6. Able to resolve integrals using the fundamental theorems of calculus and the basic formula of integration.
7. Be able to calculate the area of plane and the volume of a rotary object.
8. Able to understand geometry: point, line, conic section, surface of three-dimensional objects, reflection, Pithagoras and projection

Main Subject

1. **Matrix:** The basic concept of matrix algebra, calculating determinant, inverse matrix with adjoint matrix or elementary line operation, and solving linear equation system, determining Eigen value and Eigen vector.
2. **Real Number System:** understanding of real-number systems, Arithmetic: powers, Equations settlement, ketariutan nature and settlement of inequalities.
3. **Functions & Graphs:** Domain, range, basic functions Polynomial, Transcendent: exponential, logarithm and graphic sketch
4. **Trigonimetry:** the definition of sinus, cosine, tangent and graph of trigonometric functions, trigonometric similarities, the set of equations solving in trigonometric spikes
5. **Differential and derivative:** derived definition, base-class formula, chain rule, max / min application on polynomial function
6. **Integral:** Definition, the basic nature of indefinite integrals, the basic formula int indefinite, Int uncertain with substitution, partial integrals, certain integrals with fundamental theorems of calculus 1

7. **Integral Applications:** Plane area, volume of rotary objects. 8. **Geometry:** two-dimensional coordinate system, line, parallel or perpendicular line, Scale, midpoint between 2 points, Pytagoras, distance of two points, scale, cone delineation, Reflection, Projection, angle.
Prerequisites
Reference
1. Tim Dosen Jurusan Mathematics ITS, *Buku Ajar Kalkulus I* , Edisi ke-4 Jurusan Mathematics ITS, 2012 2. Anton, H. dkk, *Calculus*, 10-th edition, John Wiley & Sons, New York, 2012
Supporting Reference
1. Kreyzig, E, *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore, 2011 2. Purcell, J, E, Rigdon, S., E., *Calculus*, 9-th edition, Prentice-Hall, New Jersey, 2006 3. James Stewart , *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada,2012

Course	**Course Name**	**: Mathematics**
	Course Code	**: KM184152**
	Credit	**: 3**
	Semester	**: 2**

Description of Course	
This course equips students of matrix concepts, deteminan and systems of linear equations of mathematical thinking concepts in solving engineering problems, modeling and others in engineering related to differential applications. The lecture material is more emphasized on the technique of solving real problems that can be formulated into the function of one independent variable. Lecture materials include: matrices and determinants, solving systems of linear equations, Eigen values and vectors of Eigen, real number systems (real number ordering), functions and basic gifts of polynomial, exponential and logarithmic, derivatives and applications and integral, sequences and series	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically

Course Learning Outcome

1. Able to understand the matrix and its determinants and its properties and able to solve the system of linear equations, determine the value of Eigen and vector Eigen.
2. Able to understand the notion of the system of real numbers, the decimal forms of real numbers, real coordinates, the nature of obedience, inequality.
3. Able to understand the function of polynomial and transcendent functions and able to draw the basic graph, demand and supply function, economic equilibrium point.
4. Able to differentiate the explicit function, apply chain rules
5. Able to specify max / min values for functions related to economic field.
6. Able to solve the integral using the fundamental theorem of calculus and the basic formula of integration, integral with substitution and partial integral.
7. Be able to define sequences and series and be able to Understand the limit of the sequence to the infinite , series: arithmetic, geometry. Function limit associated with bank interest : $\lim_{n\to\infty}\left(1+\frac{r}{n}\right)^n$

Main Subject

1. **Matrix:** The basic concept of matrix algebra, calculating determinant, inverse matrix with adjoint matrix or elementary line operation, and solving linear equation system, determining Eigen value and Eigen vector.
2. **Real Number System:** the definition of the real number system, Arithmetic: powers, Equations settlement, ketesutan nature and settlement of Inequality.
3. **Functionand graphs:** Domain, range, basic functions Polynomial, Transcendent: exponential, logarithm along with graphic sketches, demand and supply functions, economic equilibrium points.
4. **Derivatives:** Able to lower (differentiate) the explicit function, adapt the chain rules
5. **Derived application:** max / min values for functions related to economic fields.
6. **Integral:** Definitions, Basic properties Integral and Int basic formula, Integration with Substitution, Partial Int. (fs polynomial and transcendent)

7. **Sequences and series:** limit of row to infinity, series: arithmetic, geometry, function limit associated with bank interest: $\lim_{n\to\infty}\left(1+\frac{r}{n}\right)^n$
Prerequisites
Reference
1. Tim Dosen Jurusan Mathematics ITS, *Buku Ajar Kalkulus I* , Edisi ke-4 Jurusan Mathematics ITS, 2012 2. Anton, H. dkk, *Calculus*, 10-th edition, John Wiley & Sons, New York, 2012
Supporting Reference
1. Kreyzig, E, *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore, 2011 2. Purcell, J, E, Rigdon, S., E., *Calculus*, 9-th edition, Prentice-Hall, New Jersey, 2006 3. James Stewart , *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada,2012

Course	**Course Name**	**: Mathematics**
	Course Code	**: KM184153**
	Credit	**: 2**
	Semester	**: 2**

Description of Course	
This course equips students of matrix concepts, deteminan and systems of linear equations of mathematical thinking concepts in solving engineering problems, modeling and others in engineering related to differential applications. The lecture material is more emphasized on the technique of solving real problems that can be formulated into the function of one independent variable. The lecturing material includes: matrix and determinant, solving system of linear equation, Eigen value and vector Eigen, real number system (base real number), limit, function and gafik base, function continuity, derivative and its application and integral, Row and polar coordinate	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically

Course Learning Outcome

1. Able to understand the matrix and determinants and their properties and able to solve the system of linear equations, determine the value of Eigen and vector Eigen.
2. Able to understand the notion of the system of real numbers, the decimal shapes of real numbers, real coordinates, the nature of obedience, inequality, mamapu understand complex numbers and properties of its nature.
3. Able to understand Domain, range, linear function, quadratic, function graph, function limit and continuity.
4. Able to lower (differentiate) explicit function, mendaptak chain rules.
5. Able to understand the Interval function up / down, kecekungan, extreme value with the first & second derivative test, the function graph, determine the max / min value of a function.
6. Able to solve the integral using the basic formula of integration, integral with substitution and partial integral and able to understand the fundamental theorem of calculus.
7. Ability to apply integration to calculate Area of flat field, volume of rotary object
8. Be able to understand the Polar Coordinate, and apply it to calculate the Plane area

Main Subject

1. **Matrix:** The basic concept of matrix algebra, calculating determinant, inverse matrix with adjoint matrix or elementary line operation, and solving linear equation system, determining Eigen value and Eigen vector.
2. **Number System:** Real number (definition of real number system, Arithmetic: force, Equation settlement, ketesutan nature and settlement of Inequality) and Complex number.
3. **Concepts of function, limit**: Domain, range, linear function, quadratic, function graph, function limit and continuity.
4. **Application Derived:** the definition of descending (differentiating), rules of differentiation rules, chain rules,
5. **Derived app:** Rising interval. descending, extreme, extreme value with first & second derivative test, function graph.
6. **Integral:** Definitions, basic properties Integral and Integral basis, Integration with Substitution, Partial Integration. Specific integral.
7. **Application integration:** Plane area, the volume of a rotary object
8. **Polar Coordinates:** Polar Coordinates, Plots of flat areas

Prerequisites
Reference
1. Tim Dosen Jurusan Mathematics ITS, *Buku Ajar Kalkulus I* , Edisi ke-4 Jurusan Mathematics ITS, 2012 2. Anton, H. dkk, *Calculus*, 10-th edition, John Wiley & Sons, New York, 2012
Supporting Reference
1. Kreyzig, E, *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore, 2011 2. James Stewart , *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada,2012 3. Mathematics for Economics and Business, 8/E…., Ian Jacques, Formerly of the University of Conventry, 2015

Detail of Courses in Analysis and Algebra RMK

Course	**Course Name**	**: Mathematical Logic**
	Course Code	**: KM184102**
	Credit	**: 3**
	Semester	**: 1**

Description of Course	
In this course students will learn about the basic terms of logic, Sentential Logic, truth table and tautology, Theory of Inference: argumentation, proof; Predicate logic: the use of quarters, inference involving quarters and Introduction to Set theory. In learning in the classroom students will be given understanding and explanation related to the material taught according to teaching materials. Besides, it is given tasks that lead to self-study and group work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	

1. Students are able to compile and compare logical true statements.
2. Students are able to apply inference rules to prove the validity of an argument in propositional logic.
3. Students are able to apply predicate logic inference rules to prove the validity of an argument involving universal or existential quarters.
4. Students are able to apply the basic characteristics of set theory in proof of argumentation.
5. Students are able to explain the relation of fundamental concepts of mathematical logic and with other branches of science.

Main Subject

In this course students will study the following subjects: Basic terms of logic; Sentential logic: a connecting sentence, a sense of necessary condition and sufficient conditions; truth and tautology tables; Theory of Inference: argumentation, proof; Predicate logic: the use of quarters, inferences involving quarters; Introduction to Set Theory: set operations, Venn diagrams, proofs using set properties.

Prerequisites

Reference

1. Yunus, M., "*Logika: Suatu Pengantar"*, Graha Ilmu, Yogyakarta, 2007

Supporting Reference

1. Copi, I.M., Symbolic Logic, 5th ed., Prentice Hall, Singapore, 1979
2. Rubin, J.E., Mathematical Logic: Application and Theory, Holt, Rinehart, and Winston, New York, 1997
3. Suppes, P., Introduction to Logic, Dover Publications, Inc., New York, 1999
4. Suppes, P. and Hill, S., First Course in Mathematical Logic, Dover Publications, Inc., New York, 2002
5. Waner, S. and Costenoble, S.R., Finite Mathematics, 2nd edition, Brooks/Cole Publishing Co., New York, 2001

Course	**Course Name**	**: Analytic Geometry**
	Course Code	**: KM184103**
	Credit	**: 3**
	Semester	**: 1**

Description of Course	
In this course, students will learn the Cartesian Coordinate, the position of points and their equations, magnitude geometry; Types of Conical sections, equations of tangents and normal lines, coordinate transformation. Students will learn to understand and able to explain the material on analytic geometry, especially flat geometry.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. Students able to explain basic principles of theory related to objects in plane geometry 2. Students able to relate basic concepts of plane geometry to some applications	
Main Subject	

Cartesian coordinate: line equations, distance of two points, distance of line and point, angle between two lines, conical wedge: equation of circles, parabola, ellipse, and hyperboles, equation of tangent and normal lines over circles, coordinate transformation, equation for sphere, cylinder, Paraboloids, Hyperboloids.
Prerequisites
Reference
1. Riddle D. F., "Analytic Geometry", PWS Publishing Company, Boston, 1995.
Supporting Reference
1. Parker, L., George Wentwoprth, David Eugene Smith; Analitic Geometry; Ginn and Company; Boston; 1922.

Course	**Course Name**	**: Elementary Linear Algebra**
	Course Code	**: KM184203**
	Credit	**: 4**
	Semester	**: 2**

Description of Course	
Elementary Linear Algebra courses are a prerequisite for taking some of the next courses in the Department of Mathematics. Discussion topics include systems of linear equations and their solutions, matrix algebra, inverse matrices, determinants and n-dimensional real vector spaces including vector operations, norms of vectors, dot products on $\mathcal{R}^n$,cross products on $\mathcal{R}^n$, basis, Row Space, Column Space, and Null Space, rank and nullity of the matrix, Matrix transformations, Eigenvalues, Eigenvectors and diagonalization of matrices, inner product spaces	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	

1. Students are able to follow developments and apply math and be able to communicate actively and correctly either oral or written 2. Students are able to explain intelligently and creatively about the significant role of ALE applications in the field of related knowledge clusters and other fields 3. Students have a special ability and able to process their ideas enough to support the next study in accordance with the related field 4. Students are able to present their knowledge in ALE independently or in teamwork
Main Subject
Systems of Linear Equations, Determinants, Real vector Space, Eigenvalues and Eigenvectors, Inner product spaces
Prerequisites
Reference
1. Howard Anton and Chris Rorrers, ”Elementary Linear Algebra, Tenth Edition", John Wiley and Sons, (2010).
Supporting Reference
1. C.D. Meyer,”Matrix Analysis and Applied Linear Algebra”, SIAM, (2000) 2. Steven J. Leon, "Linear Algebra with Applications", Seventh Edition, Pearson Prentice Hall, (2006). 3. Stephen Andrilli and David Hecker,”Elementary Linear Algebra, Fourth Edition”, Elsevier, (2010) 4. Subiono., ”Ajabar Linier”, Jurusan Mathematics FMIPA-ITS, 2016

Course	**Course Name**	**: Algebra I**
	Course Code	**: KM184402**
	Credit	**: 3**
	Semester	**: 4**

Description of Course	
The discussion of the Algebra I course covers the study of Relation, Functions and Groups, Subgroups and Generators, Smallest Subgroups, Permutations Groups, Normal Groups and Quotient Groups, Group Homomorphisms, internal and external direct products and Cayley Theorem. In the discussion of lectures used SAGEMATH software to equip learners have the ability to perform symbolic computation related to group problems. In the learning process in the classroom learners will learn to identify problems, express symbolic math ideas and express them into writing. In addition to being directed to independent learning through tasks, learners are directed to cooperate in group work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally

4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

Course Learning Outcome

1. Students are able to follow developments and apply math and be able to communicate actively and correctly either oral or written
2. Students are able to explain basic and advanced principles of the Theory they understand in particular with regard to the structure of a finite group and capable of performing symbolic computations
3. Students are able to explain intelligently and creatively about the significant role of Algebra I application in the field of related knowledge or other fields
4. Students are able to present their knowledge in ALJABAR I independently or in team work.

Main Subject

Relation, functions and groups, subgroups and generators, permutation groups, normal groups and quotient groups, Group Homomorphisms, internal and external direct products and Cayley Theorem.

Prerequisites

Reference

1. Subiono, "Catatan Kuliah : ALJABAR I", Department of Mathematics of ITS, 2014.
2. Randall B. Maddox," A Transition to Abstract Mathematics, Learning Mathematical Thinking and Writing, 2nd Edition", Academic Press, (2009)
3. Joseph A. Gallian, "Contemporary Abstract Algebra", 7th Edition, D.C. Heath and Company, (2010)

Supporting Reference

1. Derek J. S. Robinson, "An Introduction to Abstract Algebra", Walter de Gruyter, (2003).
2. William Paulsen," Abstract Algebra, An Interactive Approach", CRC Press, (2010)

3. Robert A. Beezer," Sage for Abstract Algebra, A Supplement to Abstract Algebra, Theory and Applications ", Department of Mathematics and Computer Science University of Puget Sound, (2012)

Course	**Course Name**	**: Analysis I**
	Course Code	**: KM184501**
	Credit	**: 4**
	Semester	**: 5**

Description of Course	
In this course, students will study the real number system, i.e. a system that has complete ordered field properties, definition of convergent sequences, a monoton and bounded sequence, Cauchy sequence, limits of function, continuous and uniformly continuous function and derivative of functions.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. Students able to explain basic principles from the theory, especially those that are related to the real number systems. 2. Students able to explain basic principles related with convergence of sequences and its proving concepts.	

3. Students able to relate the concept of convergence in limit and continuity of functions. 4. Students able to explain basic concepts related to derivative of functions and its properties, also its applications to some theorems.
Main Subject
Real number systems, absolute values from their geometric and neighborhood definition, supremum and infimum and its applications, convergent, monoton and bounded sequences, subsequences, divergence criteria, Cauchy sequences, contractive sequences, limit of functions, the existence of limits and the squeeze principle, continuous functions, discontinuous and uniformly continuous functions and Lipschitz conditions, their derivative functions and its properties also their applications to the Rolle theorem and mean value theorem.
Prerequisites
Mathematical Logic Discrete Mathematics
Reference
1. Bartle R G and Sherbert D R," Introduction to Real Analysis", 4th Edition, John Wiley & Sons, Inc. 2011 2. Sunarsini dan Sadjidon, "Modul Ajar: *Analisis Riil I*", Jurusan Mathematics FMIPA-ITS, 2014.
Supporting Reference

Course	**Course Name**	**: Vector Calculus**
	Course Code	**: KM184502**
	Credit	**: 2**
	Semester	**: 5**

Description of Course	
In this course is studied about vector space, algebra vector, differential and integral vector, gradient, divergence and curl of vector function, Green theorem and Stokes theorem.	
Learning Outcome	
3.1.1.	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2.	The students are able to identify simple problems, form mathematical models and solve them
3.1.3.	The students are able to understand the basic methods in mathematics
3.2.1.	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1.	The students are able to understand mathematical problems, analyze and solve them
4.3.1.	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. The student able to understand and use the differential and integral vector 2. The student able to determine the gradient, divergence and curl of vector function 3. The student able to prove Green, Stokes divergence theorem	
Main Subject	

Vector algebra, Vector Fields, Line Integrals, Line Integrals of Vector Fields, The Fundamental Theorem for Line Integrals, Independence of Path , Green's Theorem, The Curl and Divergence of a Vector Field, Parametric Surfaces and their Areas, Oriented Surfaces, Surface Integrals of Vector Fields, Stokes Theorem, The Divergence Theorem
Prerequisites
Multivariable Calculus
Reference
1. Howard Anton, IRL Bivens, Stephen Davis, "Multivariables Calculus", 9th Edition, John Wiley & Sons, Inc, Singapore, 2009
Supporting Reference
1. Purcell J.E., Rigdon S.E., Vargerg D. "Calculus", Prentice Hall, New Jersey, 2000

Course	**Course Name**	**: Algebra II**
	Course Code	**: KM184504**
	Credit	**: 3**
	Semester	**: 5**

Description of Course	
Discussion of Algebra II courses includes assessment of ring, integral Domains, field, characteristic of ring, ideal and Quotient rings, Ring Homomorphisms and Division field. In the lecture discussion used SAGEMATH software to equip learners have the ability to perform symbolic computation related to the problem of algebra with two binary operations. In the learning process in the classroom learners will learn to identify problems, express symbolic math ideas and express them into writing. In addition to being directed to independent learning through tasks, learners are directed to cooperate in group work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction

4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field

Course Learning Outcome

1. Students are able to follow developments, develop and apply math and able to communicate actively and correctly both oral and written
2. Students are able to explain basic and advanced principles of the theory they understand in particular with regard to the structure of a finite field and capable of performing symbolic computations
3. Students are able to explain intelligently and creatively about the significant role of Algebra application in the field of related knowledge clusters and other fields
4. Students are able to present their knowledge in Algebra field independently or in teamwork

Main Subject

Ring, Integral Domains, Field, Characteristic of Ring, Ideal and Quotient Rings, Ring Homomorphisms and Division Field

Prerequisites

Reference

1. Subiono., "Catatan Kuliah : ALJABAR II", Jurusan Mathematics FMIPA-ITS, 2014.
2. Joseph A. Gallian, " Contemporary Abstract Algebra, 7th Edition", Brooks/Cole, (2010)
3. Joseph J. Rotman,"Advanced Modern Algebra", Prentice Hall, (2003).

Supporting Reference

1. William Paulsen," Abstract Algebra, An Interactive Approach ", CRC Press, (2010).
2. Robert A. Beezer," SAGE for Abstract Algebra, A Supplement to Abstract Algebra, Theory and Applications ", Department of Mathematics and Computer Science, University of Puget Sound, 2013.

Course	**Course Name**	**: Analysis II**
	Course Code	**: KM184601**
	Credit	**: 4**
	Semester	**: 6**

Description of Course	
In this course, it is studied about the definition of the Riemann integrated function and the convergence of function sequences and function series also given the understanding of Topology in real space and continuous linear operator.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. The student able to explain the principles of Riemann integral and its properties. 2. The student able to explain compact set and compact space 3. The student able to understand and explain the continue linear operator.	

Main Subject
Riemann integral, the properties of integral Riemann, Calculus Fundamental Theorem, Darboux integral, sequence of function, series of function, open and closed set, compact set, metric space, Banach space, Hilbert space, and continue linear operator.
Prerequisites
Analysis I
Reference
1. Bartle,R,G.,Sherbert, 2010, ” Introduction to Riil Analysis, Fourth Edition. 2. Bryan P. Rynne and Martin A Youngson, 2001, Linier Functional Analysis
Supporting Reference

Course	**Course Name**	**: Complex Variable**
	Course Code	**: KM184602**
	Credit	**: 3**
	Semester	**: 6**

Description of Course	
The subjects of the complex function variables address the problem: complex numbers, complex mapping, limiting, continuous, derivative, complex integral, Green Theorem, Cauchy, Morera and Liouvile, convergence / divergence sequences and series, singularities, residual theorems and their use in complex integrals, conformal mapping.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	

1. Students are able to explain the nature of algebra in complex numbers, determine limits, continuity and derivation of complex functions and can explain the properties of elementary functions: exponential functions, logarithms, and trigonometry, hyperbolic functions, and trigonometric invers
2. Students are able to calculate the integral complex functions using appropriate properties and theorems
3. Students are able to explain the mapping / transformation by elementary functions and conformal mapping / transformation
4. Students are able to explain the residual theorem and its use to compute the integral complex functions
5. Students are able to investigate series convergence, decompose complex functions in power series, Taylor, Maclaurin and Lourent series

Main Subject

Complex number system, complex variable function, limit, continuity, derivative, analytic function and harmonic function, elementary functions: exponential, logarithm, trigonometry, hyperbolic, and trigonometric inverse, complex integration, contour, theorem: Green, Cauchy, Morera and Liouvile, convergence / divergence sequence and series, singularity, residual theorem and its use in complex function integral, conformal mapping

Prerequisites

Analysis I

Reference

1. Churchil, R., "Complex Variables and Applications 8th edition", McGraw-Hill, New York, 2009.
2. Mathews, J.H, "Complex Variables for Mathematics and Engineering", 6th edition, WM C Brown Publiser, Iowa, 2010.

Supporting Reference

1. Poliouras, J.D., Meadows D. S, "Complex Variables for Scientists and Engineers 2nd edition ", New York, 2014.

Course	**Course Name**	**: Linear Algebra**
	Course Code	**: KM184702**
	Credit	**: 3**
	Semester	**: 7**

Description of Course	
Discussion of linear algebra courses includes examination of linear, linear and base sets, dimensions, direct sums, coordinates and ordered basis, linear mapping of vector spaces, linear mappings and matrix algebra, change of base, rank, determinant and inverse, echelon form of a matrix , eigenvectors and eigenvalues, matrix diagonization, orthogonality, general invers. The application of linear algebra is an integrated part in the presentation of lectures in the classroom. Also in the lecture discussion used SAGEMATH software to equip learners have the ability to perform numerical and symbolic computation. In the learning process in the classroom learners will learn to identify problems, express mathematical ideas: graphics, symbolic numeric and express it into writing. In addition to being directed to independent learning through tasks, learners are directed to cooperate in group work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them

4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field

Course Learning Outcome

1. Students are able to follow developments and apply math and be able to communicate actively and correctly either oral or written
2. Students are able to develop further understanding that has been obtained mainly related to advanced mathematics and apply it either in the field of mathematics itself or others and the ability to manipulate mathematical computations numerically and symbolically related to the matrix
3. Students have a special ability and able to process enough ideas to support the next study in accordance with the field that ditekuninya
4. Students are able to present their scientific understanding in Linear Algebra independently or in teamwork.

Main Subject

Field and vector spaces, vector spaces, spanning sets, linearly independent and base, dimensions, direct sums, coordinates and ordered basis, linear mapping of vector spaces, linear mappings and matrix algebra, change of base, rank, determinant and inverse, echelon of a matrix, eigenvector and eigenvalues, matrix diagonization, orthogonality, general invers.

Prerequisites

Elementary Linear Algebra
Algebra I

Reference

1. Subiono, ”Catatan Kuliah : ALJABAR LINIER ”, Jurusan Mathematics FMIPA-ITS, 2014.
2. Robert A. Beezer, ”A First Course in Linear Algebra, Version 3.10”, University of Puget Sound, Congruent Press, Washington, USA, (2013)
3. Gilbert Strang, ”Linear Algebra and Its Applications", 4th Edition, Thomson, (2006).
4. C.D. Meyer,”Matrix Analysis and Applied Linear Algebra”, SIAM, (2000)

Supporting Reference
1. David C. Lay, "Linear Algebra and Its Applications", Addison Wesley, (2002). 2. Steven J. Leon, "Linear Algebra with Applications", 7th Edition, Pearson Prentice Hall, (2006).

Course	**Course Name**	**: Combinatorial Analysis**
	Course Code	**: KM184704**
	Credit	**: 3**
	Semester	**: 7**

Description of Course	
In this course, the students will learn about Permutations and Combinations, The Pigeonhole Principle, The Binomial Coefficient, The Inclusion-Exclusion Principles, and Recurrence Relation. In classroom learning, the students learn and are able to understand and apply the combinatoric principles on everyday issues.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. The students are able to explain the basic principles of the theory that they understand, especially in permutations, combinations, and the pigeonhole principles.	

2. The students are able to associate the basic principles and the pigeonhole principles with recurrence relations and the inclusion-exclusion principles.
Main Subject
In this course, the students will study the following subjects: Permutations and Combinations, The Pigeonhole Principle, The Binomial Coefficient, The Inclusion-Exclusion Principles, and Recurrence Relation.
Prerequisites
Reference
1. Brualdi R. A.,"Introductory Combinatorics", Pearson Prentice-Hall, 2004
Supporting Reference

Course	**Course Name**	**: Number Theory**
	Course Code	**: KM184711**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
In this course students will learn about the properties of sharing, the greatest partnership factor and the smallest multiplicity of Alliances, the Euclide Theorem, and Bezout's identity. Relative Prime, Moduleo Algebra, Diophantin and Time equations for China, congruence and application. Students will learn and be equipped to understand and to be able to explain the material taught in accordance with the teaching materials and besides the students are able to identify daily problems related to number theory and skillfully solve the problem thoroughly.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs

4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

Course Learning Outcome

1. Students are able to explain the basic principles of the Theory they understand especially the apportionment and distribution algorithms.
2. Students are able to explain basic principles relating to the greatest partnership factor and the smallest of the Guild's alliances.
3. Students are able to relate Congruence Theorems to the problems of number theory.

Main Subject

In this course students will study the following subjects: Division and division algorithms, division properties, the greatest common factor and the smallest multiplicity of alliances, Euclid's algorithm on the greatest common factor, Bezout's identity and its application, prime and relatively prime and the theorem Fermat, Algebra Modulo and inverse modulo, linear congruence relationships, Wilson's theorem, Diophantine Equations and Congressional Theorems and Chinese residual theorems.

Prerequisites

Algebra I
Algebra II

Reference

1. Gioia, A.A., “Theory of Numbers” Dover Pub., Chicago, 2001
2. Apostol, TM, “Introduction to Analytic Number Theory”, ToppanCompany S.Pte. Ltd., Singapore, 1980

Supporting Reference

1. Ake Lindahl, L; Lectures on Number Theory; Uppsala, 2002
2. Stein, W; Elementary Number Theory; Harvard, UC San Diego; 2017

Course	**Course Name**	**: Geometry**
	Course Code	**: KM184712**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
This course provides the knowledge and understanding of the logics that begins by providing undefined elements of geometry in the form of axioms of incidence and parallel, the concept of sequence, the concept of rays, the concepts of angles and concepts of congruence. Furthermore, the following concepts will be studied and developed in the form of the theorems and proofs are analyzed and assisted by incidence geometrical objects.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs

Course Learning Outcome
1. Students able to explain undefined geometrical elements in the form of incidence geometry. 2. Students able to develop natural concepts in the form of axioms and theorems and its proof.
Main Subject
This course covers the geometry of incidence with several geometric models, the isomorphic properties and affine geometry. The concept of the order of points on the line, on the plane and space. The position of the sequence of points is developed on the concept of the sequence of rays, angles and triangles, and developed on the concept of congruence.
Prerequisites
Reference
1. Rawuh., '' Geometri '', Edisi kesatu, Universitas Terbuka Departemen Pendidikan Nasional, Indonesia, Juli 2008 2. Glencoe McGraw-Hill., "Geometry Concepts and Applications", United States of America, 2008 3. David A. Brannan, Matthew F. Esplen Jeremy J. Gray., "Geometry", Cambridge University Press, 1999
Supporting Reference

Course	**Course Name**	**: Introduction to Graph Theory**
	Course Code	**: KM184713**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
Graph Theory studied the set of vertices and edges connecting a pair of vertices. At a practical level, nodes can represent real entities and edges can represent relationships between entities. In the course, students will study the use of principles in graph theory as a tool to model a problem, solve the model and export the solution to the problem modeled.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	

Students able to understand concepts in graph theory and use it to solve problems in engineering and social, construct model and simulate it, individually or in group.
Main Subject
In this course, students will study the following subjects: basic graph theory, graph coloring, graph labeling, distance in graph, tree and its properties.
Prerequisites
Discrete Mathematics
Reference
1. Nora Hartsfield, Gerhard Ringel, "Pearls in Graph Theory", Dover Publications, Inc., 2003. 2. I Ketut Budayasa, "Teori Graf dan Aplikasinya", Unesa University Press, 2007.
Supporting Reference
1. Garry Chartrand, Ping Zhang, "A First Course in Graph Theory", Dover Publications, Inc., 2012.

Course	**Course Name**	**: Measure Theory and Integration**
	Course Code	**: KM184811**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
Measure and Integral theory lecture materials include algebraic sets, sigma algebra, Lebesgue outer size, Lebesgue size, Lebesgue measurable function, almost everywhere concept and integral Lebesgue on R. In this course, students will learn to understand and explain the basic concepts of the subject matter. As an elective course, students are directed to find topics that are appropriate to the subject matter as an independent task. These results are then presented, to furthermore be used as a final student task.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. Students able to explain concepts of algebraic sets and sigma algebra 2. Students able to explain Lebesgue measurable sets on R. 3. Students able to explain the definition of Lebesgue measurable functions	

4. Students able to explain the definition of Lebesgue integral on R and its properties.
Main Subject
In this course, students will study the following subjects: algebraic sets and sigma algebra, measure and properties, the set function, the outer measure of Lebesgue, the Lebesgue measure, Lebesgue measurable function, the concept of Almost Everywhere, the stair function and simple functions, Lebesgue integral.
Prerequisites
Analysis I Analysis II
Reference
1. Jain, P.K., Gupta, V.P., "Lebesgue Measure and Integration", Wiley Eastern Ltd, 1986. 2. Sunarsini, Diktat Kuliah :"Teori Ukuran dan Integral", 2011
Supporting Reference
2. Royden, H.L., "Real Analysis", 4th ed., Mac Millan Pub. Comp, New York, 2010.

Course	Course Name : Topics in Analysis
	Course Code : KM184812
	Credit : 2
	Semester : 8

Description of Course	
In this course, students will be given new insights on the material / topic that is under active development and as needed at this time. In this lecture, we study recent topics on analysis. The paper review of the topic is presented in the form of discussions and presentations. It is expected that some topics of the final project are offered in this course.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students able to study recent topics on analysis and algebra 2. Students able to understand a paper and present it	
Main Subject	

Materials on recent topics in analysis and algebra, related paper on analysis and algebra.
Prerequisites
Reference
Books and paper for related topics
Supporting Reference

Course	Course Name : Topics in Algebra
	Course Code : KM184813
	Credit : 2
	Semester : 8

Description of Course	
In this course will be given new insights to students about the material / topics that are developing and in accordance with current needs. In this lecture we studied new topics about algebra, both in terms of theoretical and applied. The paper / paper review of the topic is presented in the form of discussions and presentations. It is expected to appear topics of the final project.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to study new topics about algebra, both theoretical and the application 2. Students are able to understand and relay material from paper / related papers in the form of presentation	

Main Subject
Material on new topics in algebra and its applied, algebra paper / papers on related topics.
Prerequisites
Reference
1. Lidl, R. dan Pilz, G, “Applied Abstract Algebra (Undergraduate Texts in Mathematics) 2nd edition”, 1997 2. Books and papers for related topics
Supporting Reference

Course	**Course Name**	**: Fourier dan Wavelet Transformation**
	Course Code	**: KM184814**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
In this course students will learn about linear space, normed space, and inner-product spaces, Fourier series, Fourier transforms, discrete Fourier transforms, and applications. In learning in the classroom students will learn and be equipped to understand and to be able to explain the material taught in accordance with teaching materials, Besides, given the tasks that lead to self-study and group work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models

Course Learning Outcome
1. Student can present a function (signal) in Fourier expansion, and can show the accuracy of the presentation 2. Students can apply discrete decomposition / reconstruction in signal processing, especially in compression process and denoising data / signals
Main Subject
In this course students will study subjects such as linear space, normed space, and inner result space, Fourier analysis: Fourier series, Fourier transformation, discrete Fourier transformation, and application.
Prerequisites
Reference
1. Boggess, A., Narcowich, F. J., "A First Course in Wavelets with Fourier Analysis", Prentice-Hall, New Jersey, 2001. 2. Folland, G. B., "Fourier Analysis and Its Applications",American Mathematical Society., 2009.
Supporting Reference

Course	**Course Name**	**: Differential Geometry**
	Course Code	**: KM184815**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
In this course, students will learn algebraic equations in the form of parameters, Frenet Framework, The basic shape of the surface in parameters, the basic form of Gauss and Codazzi, covariant differential, hyperbolic geometry, surface theory in the form of differential. Students will learn to understand and to be able to explain the material taught in accordance with the teaching materials and besides that, the students are given some tasks that lead to self-study and group work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. Students able to explain and classify geometrical groups, especially that are related to linear algebra, calculus and differential equations 2. Students able to explain some elements of differential geometry and its applications to other fields.	

3. Students able to explain definitions, lemmas, theorems in the field of differential geometry.
4. Students able to explain and understand assumptions of events in a system model by using theorems to obtain the solutions.
5. Students able to represent a paper in the field of differential geometry independently and in groups.

Main Subject

In this course, students will study the following subjects: review of linear algebra, calculus, differential equations, algebraic equations in parametric form, local theory; Framework of the Frenet, The basic surface forms in parametric form, The basic form and Gauss mapping, the basic theorem of surface theory of the Gauss and Codazzi equations, Differential Covariance, Parallel and Geodesical Translations, Gauss-Bonnet Theorem and the Holonomy, Hyperbolic Geometry, Surface Theory in Differential Form, and Curvature on the calculus of variation and surface.

Prerequisites

Ordinary Differential Equation

Reference

1. John McCleary., ”Geometry from a Differentiabel Viewpoint”, Cambridge University Press, New York America, 1994
2. Peter W, W Michor., “Topic in Differential Geometry“, Institut fur Mathematik der Universitat Wien, Strudlhofgasse, Austria, 2006.
3. Theodore Shifrin, “Differential Geometry, A First Course in Curves and Surfaces“, University Of Georgia, 2009.

Supporting Reference

1. Ivan Kolar, Peter W. Michor, Jan Slovak., “Natural Operations In Differential Geometry “, Institut fur Mathematik der Universitat Wien, Strudlhofgasse, Austria, and Departement of Algebra and Geometry Faculty of Science, Masaryk University Janackovo, Czechoslovakia, 2000.

Detail of Courses in Applied Mathematics RMK

Course	**Course Name**	**: Multivariable Calculus**
	Course Code	**: KM184301**
	Credit	**: 4**
	Semester	**: 3**

Description of Course	
In this course students will learn about the functions of two or more independent variables, limit and continuity, partial derivatives, maximum and minimum, double and triple integrals, double integral applications, . In learning in the class students will learn and be equipped to understand and to be able to explain the material taught in accordance with the teaching materials. Besides, students are given tasks that lead to independent study and team work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically

4.5.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
4.6.2	The students are able to identify simple problems, form mathematical models and solve them

Course Learning Outcome

1. Students are able to apply vector algebra especially related to equation of line and field in space.
2. Students are able to understand the concept of multi variable functions, especially related to differentiation and integration.
3. Students are able to apply maximum and minimum problems in real phenomena.
4. Students are able to apply multiple integrals in solving real problems.

Main Subject

Vector algebra, functions of two or more independent variables, limit and continuity, partial derivatives, maximum and minimum problems, maximum and minimum with additional terms (Lagrange multiplier), double and threel integrals and its application.

Prerequisites

Mathematics 2

Reference

1. Howard Anton, IRL Bivens, Stephen Davis, "Multivariables Calculus", 9th Edition, Jhon Wiley & Sons, Inc, Singapore, 2009

Supporting Reference

1. Pulcell J.E., Rigdon S.E., Vargerg D. "Calculus", Prentice Hall, New Jersey, 2000

Course	**Course Name**	**: Operation Research I**
	Course Code	**: KM184302**
	Credit	**: 3**
	Semester	**: 3**

Description of Course	
This course is the basis of Mathematics modeling especially linear and not probabilistic. The scope of this course covers the use of Mathematics in management issues especially decision-making based on simple Mathematics modeling of real problems.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.4	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	

1. Able to understand the optimization problem in a real phenomenon in research operations and solve them using existing methods. 2. Be able to identify simple problems on transportation problems, linear programming, assignment and form Mathematics models using existing methods. 3. Able to provide an optimal solution alternative for simple problems
Main Subject
History and understanding of operations research, modeling in operations research, linear programming, standard non-standard simplex method, big M method, dual theorem, transportation problem, northwest corner method, minimum table method, Russell approach, Vogel method, MODI optimization, assignment problems, integer linear programming, network analysis, PERT, dynamic programming.
Prerequisites
Aljabar Linier Elementer
Reference
1. F.S. Hillier & G.J. Lieberman [2005], "Introduction to Operations Research ", Eighth Editions, McGraw-Hill Publishing Company, Singapore. 2. Taha, Hamdy A [2007], "Introduction to Operations Research", Fifth Editions, Prentice Hall Inc., Englewood Cliffs, New Jersey.
Supporting Reference
1. H.M. Wagner [1972], "Principles of Operations Research", Prentice-Hall, Inc., London. 2. Winston [1994], "Operation Research Applications and Algorithms", Duxbury Press Belmont, California.

Course	**Course Name**	**: Statistical Methods**
	Course Code	**: KM184305**
	Credit	**: 3**
	Semester	**: 3**

Description of Course	
This course is a basic course that is a prerequisite for taking some further courses in the department of Mathematics. This course deals with basic concepts of statistics, descriptive statistics, random variable distributions, special opportunity distributions, average sampling distributions, hose estimates of parameters, hypothesis tests, and simple linear regression. The introduction of the Minitab program is done as a tool to solve simple problems related to data processing and analysis.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

Course Learning Outcome
1. Students are able to understand simple statistical problems, analyze with statistical basic methods, and solve them. 2. Students are able to identify data, analyze it using appropriate basic statistical methods, present it orally and written in academic way. 3. Students are able to be responsible for the conclusions drawn based on data and methods which have learnt during the course.
Main Subject
Basic concepts of statistics, descriptive statistics, random variable distribution, special opportunity distributions, average sampling distributions, hose estimates of parameters, hypothesis testing, and simple linear regression
Prerequisites
Mathematics 2
Reference
1. Walpole, R.E, Pengantar statistika, edisi 3, Gramedia, Jakarta, 2002 2. Walpole, R.E, Ilmu Peluang dan Statistika untuk Insinyur dan Ilmuwan, edisi 3, ITB, Bandung, 2000 3. Gouri, BC., Johnson RA, Statistical Concepts and Methods, John Wiley and Sons, New York, 1977 4. Walpole, RE, Probability and Statistics for Engineer and Scientis, , 2016
Supporting Reference
1. Draper NR, Smith H., Analisis Regresi Terapan, Gramedia, Jakarta, 1992 2. Spiegel RM, Probability and Statistics, Kin Keong Print, Singapore, 1985

Course	**Course Name**	**: Ordinary Differential Equations**
	Course Code	**: KM184401**
	Credit	**: 3**
	Semester	**: 4**

Description of Course	
In this course students will learn about different kinds of differential equations with 1 (one) independent variable as well as methods to solve differential equations and systems of differential equations, existence and uniqueness solution, properties and behavior of solution, the stability of the system in the form of linear differential equations,. In discussion in the class students will learn and be equipped to understand and to be able to explain the material taught in accordance with the teaching materials. Besides, students are given tasks that lead to independent study and team work.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

4.6.2	The students are able to follow the developments of Science and Technology that support the work field

Course Learning Outcome

1. Students are able to identify problems with the form of ordinary differential equations and ordinary differential equations systems
2. Students are able to apply methods to solve ordinary differential equations and ordinary differential equations systems
3. Students are able to analyze the properties and behavior of the solution of the system of ordinary differential equations

Main Subject

1. Ordinary differential equations afirst order :: separation of variables, linear differential equations, exact and integration factors.
2. Second and higher differential equations: homogeneous equations, non homogeneous equations, fundamental solutions, undertemined coefficient methods, methods of parameter variation.
3. First order differential equation system: presentation of differential equations in system form, existence and uniqueness solution, properties and behavior of solution, system stability linear differential equations system, eigenvalues, Ruth Hurwitz method, Lyapunov method.

Prerequisites

Elementary Linear Algebra

Reference

1. Boyce Di Prima , ”Ordinary Differential Equation and Boundary Value Problem, 9th edition, 2005.

Supporting Reference

Course	Course Name : Probability Theory
	Course Code : KM184901
	Credit : 3
	Semester : 4

Description of Course	
In this lecture will be explained about the definition, basic concepts, the properties of opportunities and calculation techniques. It then discusses random variables, distribution functions, random variable functions and limited distribution. Basics of opportunity theory are used to represent and interpret basic populations and mathematics probabilistic models.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to explain, understand the basic concept of opportunity, random variable, distribution of random variable and its nature	

2. Students are able to identify and analyze the modeling of an event and the development of statistical Mathematics related to the concept of opportunity and random variable
Main Subject
Review of Set theory, sample space, event, algebraic sigma, Opportunity size, Opportunity definition, Opportunity properties, Conditional probability, Bayes theory, discrete and continuous distribution random variables, expected values, Moments, Moment Generating Function (MGF), discrete and special distributions continuous, discrete and continuous shared distribution, free random variable, conditional distribution, expected value properties, correlation, Conditional expectancy value, MGF joint, CDF technique, transformation method of the number of random variables, Understanding rows of random variables, central limit theorem (CLT) and approximation for Binomial distribution
Prerequisites
Statistical Methods Mathematics 2
Reference
1. Bain, L.J., Engelhardt, M.1992 , " Introduction to Probability and Mathematical statistics", Duxbury Press, 2nd.
Supporting Reference
1. Kreyszig, Introductory to Mathematical Statistic, Principles and Methods, John Wiley, 1970 2. Ross, SM, Introduction to Probability Models, Academic Pres, 1980

Course	**Course Name**	**: Numerical Methods**
	Course Code	**: KM184404**
	Credit	**: 3**
	Semester	**: 4**

Description of Course	
In this course will be studied numerical methods to complete the search of the roots of equations, systems of linear equations, systems of nonlinear equations, differential and numerical integration and curve matching. The algorithms for those methods will be studied and implemented in the programming languages studied. Furthermore, students are expected to be able to solve numerical problems related to science and technology.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.6.2	The students are able to follow the developments of Science and Technology that support the work field
Course Learning Outcome	
Students understand and can solve problems related to numerical methods that are commonly encountered in computer science and engineering problems.	
Main Subject	

In this course students will study the following subjects: error / equation definition, equation roots, Linear equation system, nonlinear equation system, interpolation, numerical derivation, numerical integration and curve matching.
Prerequisites
Reference
1. Gerald, C. F. & Wheatley O. P, 2013. " Applied Numerical Analysis 7th edition", Addison Wesley Publishing Company, California 2. Chapra, S.C. & R.P. Canale, 1989, " Metode Numerik" Edisi ke-2, Penerbit Airlangga, Jakarta
Supporting Reference
1. Burden, R.C., Faires J.D. , Reynolds, A.C., 2010, " Numerical Analysis", Brooks/Cole Cengage Learning, Boston.

Course	**Course Name**	**: Operation Research II**
	Course Code	**: KM184405**
	Credit	**: 3**
	Semester	**: 4**

Description of Course	
This course is a development of Mathematics modeling that is linear and the introduction of non-linear model. The scope of this course covers the use of Mathematics in management issues, especially decision-making based on modeling real problems.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students can understand everything related to real problems that are probabilistic.	

2. Students understand the problem of Dynamic Program, Game Theory, and can arrange the model of Non-Linear Mathematics and at the same time look for the solution. 3. Students understand and understand Theory of Supply and Queue Theory. 4. Students obtain supplies in completing the Final Project.
Main Subject
Nonlinear, multiple objective, probabilistic dynamic programming, goal programming, game theory, inventory theory and queuing theory
Prerequisites
Operation Reasearch I Statistical Methods
Reference
1. F.S. Hillier & G.J. Lieberman [2005], "Introduction to Operations Research ", Eighth Editions, McGraw-Hill Publishing Company, Singapore.
Supporting Reference
1. Taha, Hamdy A [2007], "Introduction to Operations Research", 5th Editions, Prentice Hall inc., Englewood Cliffs, New Jersey. 2. Winston [1994], "Operation Research Applications and Algorithms", Duxbury Press Belmont, California. 3. H.M. Wagner [1972], "Principles of Operations Research", Prentice - Hall, Inc., London.

Course	**Course Name**	**: Partial Differential Equations**
	Course Code	**: KM184503**
	Credit	**: 3**
	Semester	**: 5**

Description of Course	
In this lecture, we will discuss about the understanding of partial differential equations, real problems in the form of partial differential equations as well as methods and related theorems to solve them.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Able to understand physic problems or natural phenomena form in partial differential equations, analyze and solve them 2. Be able to master the right methods to solve partial differential equations, analyze the characteristics and behavior of the system	

3. Able to prove the existence and solvency of completion for the Liouville Strum problem 4. Able to cooperate in analyzing and completing natural phenomena in the form of partial differential equations 5. Able to communicate scientifically both orally and in writing
Main Subject
First order partial differential equation: existence and unity of solution, variable separation method, heat conduction equation, vibration and wave problems, Liouville Strum Problem, characteristic values and self-adjoint
Prerequisites
Ordinary Differential Equations
Reference
1. Howard Anton,1995. “Multivariables Calculus”, Jhon Wiley & Sons, Inc, Singapore . 2. Haberman, R.,“ Applied Partial Differential Equation”, 2003 3. Pinchover,Y., Rubinstein, J., An Introduction to Partial Differential Equations, Cambridge, 2005
Supporting Reference
1. Pulcell J.E., Rigdon S.E., Vargerg D,2000. “Calculus”, Prentice Hall, New Jersey. 2. Xiangmin,2009.”AppliedMultivariabel Calculus”.

Course	**Course Name**	**: Mathematical Statistics**
	Course Code	**: KM184505**
	Credit	**: 3**
	Semester	**: 5**

Description of Course	
This course is a statistical inference and is a concept of decision making in a population with sampling, which is a limiting distribution, sampling distribution, cytite estima, evaluation of point estimation and Interval Estimation.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
Course Learning Outcome	
1. Students are able to define Central Limit Theorem, asymptotic Normal distribution, statisti convergence and convergence of opportunity / distribution. 2. Students are able to explain Sampling Statistics & Distribution	

3. Students are able to explain Point Estimation and Interval Estimation. 4. Students are able to explain Sufficiency & Completeness 5. Students are able to explain Hypothesis Test.
Main Subject
1. Random variable sequence, Central Limit Theorem, Asymptotic normal distribution, statistical convergence and convergence of distribution / opportunity. 2. Sampling statistics and distribution, Distribution Z, Khi-Square distribution, T distribution, F distribution, and Beta distribution. 3. Estimation point: Estimation method is Method of Moment and Method of MLE (Maximum Likelihood Est), Estimate criterion criteria: Unbiased, UMVUE, Lower limit Cramer Rao, efficient, consistent and statistically enough, exponential family (REC), complete enough statistics Lehman Theorem Scheffe. 4. Confidence interval, pivotal quantity method, and general method, and two sample problems
Prerequisites
Probability Theory Statistical Methods
Reference
1. Bain, L.J., Engelhardt, M. , " Introduction to Probability and Mathematical statistics", Duxbury Press, 2nd., 1992
Supporting Reference
1. Hogg, R.V., Tanis, E.A, "Probability and Statistical Inference", Pearson Education, 2006 2. Casella, G., Berger, R.L., " Statistical Inference", Brooks/Cole Pub.Co., 1990

Course	**Course Name**	**: Mathematical Method**
	Course Code	**: KM184603**
	Credit	**: 3**
	Semester	**: 6**

Description of Course	
This course equips students with certain methods in solving real problems such as signal smoothing, magnetic field and virtually any solution. This course supports higher-level lectures such as mathematical modeling, probability theory, image processing and boundary value issues Lecture materials include: Special functions (Gamma, Beta, Bessel, Legendre) and transformation (Laplace and Fourier transforms)	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
Course Learning Outcome	
1. Students understand the basic concepts of mathematical methods. 2. Students are able to apply basic mathematical methods in solving real problems.	
Main Subject	
In this course students will study the following subjects: beta function and gamma function, solving differential equations with series, Bessel function,	

Legendre function, Laplace transformation and its application, series and Fourier transform.
Prerequisites
Reference
1. Potter dan Goldberg, "Mathematical Methods", Prentice Hall International, New Jersey, 1987 2. Erwin Kreyzig, "Advance Engineering Mathematics 9th edition ", Jon Wiley and Sons Inc, 2006. 3. Usadha, IGN, "Modul Ajar Metode Mathematics, 2009
Supporting Reference

Course	**Course Name**	**: Mathematical Systems**
	Course Code	**: KM184604**
	Credit	**: 4**
	Semester	**: 6**

Description of Course	
Discussion of the Mathematics course of the system includes the study of the dynamics system mathematics model, the formation of the state space system, stability analysis, control analysis, the analysis of the observation, the formation of the system controller, the feedback system, the transfer function and the realization of the transfer function in the state space. In the discussion of lectures used software to equip learners have the ability to do computation related to the topic of discussion. In the learning process in the classroom learners will learn to identify the problem, express the idea of Mathematics and express it into writing. In addition to being directed to independent learning through tasks, learners are directed to cooperate in group work.	
Learning Outcome	
4.1.2	The students are able to identify simple problems, form mathematical models and solve them
4.3.1	The students are able to understand mathematical problems, analyze and solve them
4.4.1	The students are able to analyze phenomenons through a mathematical model and solve it
4.6.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. Be able to identify natural phenomena and technical problems in the form of dynamic systems 2. Able to analyze the dynamics of the system, especially the stability, control and kesamatannya and able to arrange input controller system 3. Able to form a transfer function and relate to the realization of the system in the form of a state space	

4. Able to cooperate in analyzing the dynamic system and present it in written and oral form well
Main Subject
Dynamic system mathematics model, establishment of state space system, stability analysis, control analysis, observation analysis, formation of system controller, feedback system, transfer function, realization of transfer function in state space.
Prerequisites
Reference
1. Olsder, G.J, " Mathematical System Theory", 1999 2. Ogata K, *"Modern Control Engineering"*, Fifth Edition, 2010
Supporting Reference
1. Zak, S.H, "Systems and Control", Oxford University Press, 2003

Course	**Course Name**	**: Mathematics Modeling**
	Course Code	**: KM184701**
	Credit	**: 4**
	Semester	**: 7**

Description of Course	
In this lecture discusses the formation of mathematical models based on applicable physical laws and measurement data.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Be able to explain the components to form a mathematical model 2. Able to form mathematical models based on applicable laws of physics and measurement data	
Main Subject	
Basic concept of modeling: modeling components, variables, parameters; data; modeling based on the laws of physics: the problem of heat conduction, vibration, wave, population growth; modeling based on measurement data: time series model, parameter identification.	

Prerequisites
Reference
1. Widodo,B., Pemodelan Mathematics, ITS Press, 2012 2. Lennart Ljung, System Identification, Wiley Encyclopedia of Electrical and Electronics Engineering, Wiley, 1999 3. Bellomo.N, Angelis.E.D, and Delitala.M, 2007," Lecture Note on Mathematical Modelling in Applied Sciences" Department of Mathematics Politecnico Torino Corso DucaDegli Abruzzi 24. 10129 Torino, Italy 4. Taylor H.M, Karlin.S,1998," An Introduction to Stochastic Modeling", *Academic PressLimited*, Third Edition
Supporting Reference

Course	**Course Name**	**: Mathematics Writing**
	Course Code	**: KM184703**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
In this lecture discussed about the technique of extracting ideas for the topic of Final / research, scientific writing techniques and presentations. After taking this course students are expected to produce the final project proposal.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Able to make a Final Project proposal and research 2. Be able to present the proposal 3. Be able to write papers and present	
Main Subject	

Excavation of thesis topics / mathematical research, scientific writing techniques, presentation techniques.
Prerequisites
Reference
1. Martha Davis, Scientific Papers and Presentation, Academic Press, 2005 2. Buku Panduan Akademik ITS, 2014
Supporting Reference

Course	**Course Name**	**: Non Linear Differential Equation**
	Course Code	**: KM184714**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
In this course is studied about the natural phenomena with non linear differential equation form, linearization, stability analyze methods, bifurcation analyze.	
Learning Outcome	
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. The student able to identify the natural phenomena with non linear differential equation 2. The student able to analyze the stability of non linear dynamical system with the exact method. 3. The student able to identify the bifurcation and its type. 4. The student can do as work team to analyze the non linear dynamical system	

Main Subject
First orde differential system form, linearization, stability analyze by using pole placement, Routh Hurwitz and Lyapunov method. Bifurcation analyze.
Prerequisites
Ordinary Differential Equation
Reference
1. Verhulst F., " Non Linier Differential Equation and Dynamical Systems", Springer, 2013.
Supporting Reference

Course	**Course Name**	**: Finite Difference**
	Course Code	**: KM184715**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
Discussion of different equations courses covers basic problems in Calculus Differences Up to and can use them on applied issues.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to follow the development and apply Mathematics and able to communicate actively and correctly either oral or written 2. Students are able to explain the basic principles of different calculus to and methods of completion 3. Students are able to explain intelligently and creatively about the significant role of different calculus in the field of related knowledge or other fields.	

Main Subject
Backward and forward difference, Newton's interpolation, computing series by using finite difference, Finite difference equations and integrations, and the application of finite difference in solving differential equations.
Prerequisites
Numerical Methods
Reference
1. Richardson, C., H., "An Introduction to the Calculus Finite Differences", Literacy Licencing, 2012. 2. Shochiro Nakamura, "Applied Numerical Methotds with software", Prentice-Hall International, Inc., 1991
Supporting Reference

Course	**Course Name**	**: Introduction to Dynamic Optimization**
	Course Code	**: KM184716**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
The discussion of the dynamic optimization course includes the study of the basics of calculus variation, and the approach of calculus varasi on optimal control. In the learning process in the classroom learners will learn to identify problems, model. In addition to being directed to independent learning through tasks, learners are directed to cooperate in group work.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
Course Learning Outcome	
1. Students are able to follow the development and apply Mathematics and able to communicate actively and correctly either oral or written.	

2. Students are able to explain basic and advanced principles of the Theory they understand especially in relation to the optimization design formulation and the method of completion
3. Students are able to explain intelligently and creatively about the significant role of the optimization system in the field of related knowledge clusters or other fields.

Main Subject

Basic Concepts, Function and Functional, Optimum of a Function and a Functional, The Basic Variational Problem, Fixed-End Time and Fixed-End State System, Discussion on Euler-Lagrange Equation , Different Cases for Euler-Lagrange Equation, The Second Variation , Extrema of Functions with Conditions, Extrema of Functionals with Conditions, Variational Approach to Optimal Control Systems.

Prerequisites

Reference

1. Naidu, D.S, Optimal Control Systems, CRC Press, 2002
2. Bolza, O. Lectures on the Calculus of Variations, American Mathematical Society; 3 edition (October 31, 2000)

Supporting Reference

1. Subchan, S and Zbikowski, R., Computational Optimal Control: Tools and Practice, Wiley, 2009.

Course	Course Name : Practical Work
	Course Code : KM184717
	Credit : 2
	Semester : 7

Description of Course	
This academic activity is conducted outside the campus or in an institution that is in line with the Modeling and Simulation system laboratories, therefore the discography of the courses adjusts to the tasks assigned to the supervisor in the practical workplace.	
Learning Outcome	
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Be able to apply accepted theories to workplace situations of practice. 2. Able to provide alternative solutions based on accepted theory. 3. Able to make a report of the practical work that has been done in the company.	

Main Subject
Subjects are some of the subjects studied at the Mathematics Department of FMKSD-ITS include Mathematics Modeling, Dynamic Optimization, Optimal Control, Numerical PDP, Mathematical Systems.
Prerequisites
Reference
Supporting Reference

Course	**Course Name**	**: Introduction to Financial Mathematics**
	Course Code	**: KM184718**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
This subject presents the discrete basics of Financial Mathematics covering basic probability theory and discrete random variables, Brownian geometric motion, and current concepts and value analysis. Furthermore, the discussion focused on two financial derivative products namely European and American options where the pricing option is done through arbitrage. The option pricing model discussed is the Black-Scholes model and the numerical method discussed is the binomial method. In addition, the implementation of Brownian geometric motion on stock prices and crude oil prices will be discussed as enrichment.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software

4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field

Course Learning Outcome

1. Understand the problems in finance through the Mathematics model, analyze and solve them
2. Be able to apply a mathematical thinking framework and identify financial problems in financial terms. To further model and solve problems analytically and empirically

Main Subject

The concept of probability and random variables, stochastic processes, Brownian geometric motion, interest concepts and present value analysis, European and American options, contract price through arbitrage, arbitrage theorem, binomial method, Black Scholes formula, optimization model, advanced geometric Brownian motion.

Prerequisites

Probability Theory

Reference

1. Ross, M. Sheldon, An Introduction to Mathematical Finance, Cambridge University Press, 1999

Supporting Reference

1. John C Hull, “Options, Futures, and Other Derivatives”, Pearson, 2009

Course	**Course Name**	**: Stochastic Process**
	Course Code	**: KM184719**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
This course deals with the basics of stochastic processes, Simple random walks, discrete Markov time chains (RMWD) and examples of RMWD models, State Classification, Transient Distribution, Limiting Behavior, First Passage Time, Occupancy Times, Markov Chain Continuous Time (RMWK), Homogenous Poisson Process and Non Homogeneous, Birth Death Process, Queue Model.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

Course Learning Outcome
1. Being able to understand the basics of stochastic processes and analyze a phenomenon through a mathematical thinking framework then resolve it optimally 2. Be able to identify simple real problems, model them mathematically and solve them optimally 3. Able to propose alternative solutions using a stochastic approach to simple problems individually or in groups
Main Subject
The concept of Stochastic processes, Simple random walks, Discrete Time Discrete Chain (RMWD) and examples of RMWD model, State Classification, Transient Distribution, Limiting Behavior, First Passage Time, Occupancy Times, Markov Chain Continuous Time (RMWK), Homogenous Poisson Process and Non Homogen, Birth Death Process, Model Queue.
Prerequisites
Probability Theory Mathematical Statistics
Reference
1. Kulkarni, V.G, "Modelling, Analysis, Design, and Control of Stochastic System", Springer Verlag, New York, 1999 2. V.G. Kulyarni, 1999."Modelling,Analysis,Design,and Control of Stochastic System". Springer Verleg New York
Supporting Reference
1. Allen Linda J.S, An Introduction to Stochastic Processes with Application to Biology, Pearson Education, 2003 2. Ross, S.M, Stochastic Processes, John Wiley and Sons, 1996

Course	**Course Name**	**: Quality Control**
	Course Code	**: KM184720**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
In this course we introduce about the concept of control and quality improvement statistically. Further discussed about methods of control and quality improvement based on statistics such as control charts, process capability, acceptance sampling and operating characteristic curves.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	

1. Able to understand the concept of control and quality improvement statistically from a process and analyze it. 2. Be able to identify and analyze quality data in a process to draw conclusions about the quality and ability of the process and present it scientifically 3. Able to complete and provide alternative solutions in quality improvement with the approach being studied both independently and in teamwork
Main Subject
Concept of control and quality improvement, quality control methods, sample and population, descriptive statistics, opportunity distribution, inferencing statistics, parameters and statistics, sampling concepts, parameter estimation, confidence interval, hypothesis testing. Graph handler, process capability, acceptance sampling, operating characteristic curve.
Prerequisites
Statistical Methods Probability Theory
Reference
1. Mitra A, "Fundamentals of Quality Control and Improvement", Jon Wiley and Sons Inc, 2008. 2. Montgomery C. Douglas, Statistical Quality Control, Wiley, 2009
Supporting Reference

Course	**Course Name**	**: Optimum Estimation**
	Course Code	**: KM184816**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course examines classical estimates, deterministic observers, stochastic observers (estimation of stochastic dynamic systems), their formation and application for linear stochastic dynamic problems.	
Learning Outcome	
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
Course Learning Outcome	
1. Able to understand the problem of dynamic system estimation, know the methods of estimation both classical and modern and able to apply it appropriately 2. Able to analyze natural pheneomena; identify the Mathematics model, estimate the variables by forming a good computer programming algorithm 3. Able to cooperate in presenting small topics related to optimum estimation in both written and oral form	
Main Subject	
Classical estimation theory, deterministic observer, stochastic observer, Kalman filter, Applied Kalman filter, Color Noise.	
Prerequisites	
Elementary Linear Algebra	

Ordinary Differential Equations
Reference
1. Phil Kim, Lynn Huh, “Kalman Filter for Beginners : with MATLAB Examples”, A-JIN Publishing Company, 2010 2. Dan Simon, “Optimal State Optimation”, John Wiley and Son, 2006
Supporting Reference
1. Lewis, F., “Optimal Estimation”, John Wiley & Sons, Inc, 1986. 2. Grewal, Mohinder, S., ”Kalman Filtering Theory and Practise Using MATLAB”, John Wiley &Sons, Inc., 2008

Course	**Course Name**	**: Introduction to Dynamic Systems**
	Course Code	**: KM184817**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
In this course we will discuss about continuous dynamic system and discrete dynamics system.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.3	The students are able to analyze systems and optimize their performance
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to explain and give examples of dynamic systems 2. Students are able to explain and give examples about the solution of linear dynamic system and theorem of manifestation and unity 3. Students are able to explain and give examples about behavioral analysis system	

4. Students are able to explain and give examples of bifurcation analysis
5. Students are able to explain and give examples of sequence and construction of dynamic models
6. Students are able to explain the equilibrium point and perform stability analysis

Main Subject

CONTINU DYNAMIC SYSTEM

Introduction to the definition of Dynamic Systems as a dynamic mathematical model in the form of differential equations. with some examples of the development of this science. Completion of the system as a model of linear differential equations and not linear theorem of embodiment and singularity, analytical settling, completion of geometric approaches in the form of trajectories, some examples of stability analyzes showing linear system behavior around the equilibrium point and geometrically in the phase or phase photon phase.

Stability analysis of nonlinear cervical behavior around the equilibrium point, Bifurcation linearization, Introduction of bifurcation type in prey predator system, Hofp bifurcation, Supercritical bifurcation.

DISCRETE DYNAMIC SYSTEM

1. Row and model construction with some examples of function iteration, logistic growth
2. Applied to the problem of life science
3. Equilibrium Point
4. Determining Stability.

Prerequisites

Non Linear Differential Equations

Reference

1. Ferdinand Verhulst, 1985."Non Linier Differential Equations and Dynamical Systems " *Published by Epsilon Uitgaven, Utrecht*
2. John K. Hunter, 2011," Introduction to Dynamical Systems" *Department of Mathematics, University of California at Davis*

Supporting Reference

Course	**Course Name**	**: Experiment Design**
	Course Code	**: KM184818**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course discusses the basic concepts of experimental design, one-factor experimental design in RAL, RAKL and RBSL, two-factor experimental design in RAL and RAKL, average test after ANOVA, mean square expectations, and model assumption testing.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
1. Students are able to understand basic concept of design of experiment	

2. Students are able to determine environmental factor and system measurement which are used in design of experiment to get optimal response
3. Students are able to compare two different treatments based on historical data
4. Students are able to design an experiment with more than two treatments.
5. Students are able to identify and process data obtained by the design of experiment accurately and make a decision based on the results.

Main Subject

Basic concepts of design of experiment, classification of design of experiment, comparison of two treatments, one factor design of experiment in RAL, RAKL, RBSL, mean testing after ANOVA, two factor experiment design in RAL and RAKL, average test after ANOVA, mean square expectation, and model assumption testing.

Prerequisites

Statistical Methods

Reference

1. Mattjik, AA., Sumertajaya M., "Perancangan percobaan dengan aplikasi SAS dan Minitab, jilid 1", IPB Press, Bogor, 2000
2. Box GEP., Hunter WG, Hunter JS, "Statistic for Experimenters, Design, Innovation and Discovery, 2nd Ed., John Wiley & Sons Inc., NewYork, 1995

Supporting Reference

1. Montgomery DC., "Design and Analysis of Experiments, 8th Edition, John Wiley & Sons, New York, 2011

Course	**Course Name**	**: Topics in Modeling, System, and Simulation**
	Course Code	**: KM184819**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course examines new topics of modeling, optimization and other applied. Paper / paper studies on the topic are presented in the form of discussions and presentations. It is hoped that the topics of the final project will arise.	
Learning Outcome	
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to study new topics about analysis and algebra 2. Students are able to understand and relay material from paper / related papers in the form of presentation	

Main Subject
Materials on new topics of analysis and algebra, paper / analysis and algebra papers on related topics.
Prerequisites
Reference
1. Books and papers for related topics
Supporting Reference

Course		
	Course Name	**: Topics in Stochastic, Optimization and Risk**
	Course Code	**: KM184820**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course covers new topics on Stochastic, Optimization and Risk. The paper / paper review of the topic is presented in the form of discussions and presentations. It is expected to appear topics of the final project.	
Learning Outcome	
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to study new topic on Stochastic, Optimization and Risk 2. Students are able to understand and relay material from paper / related papers in the form of presentation	

Main Subject
Materials on new topics Stochastic, Optimization and Risk, Stochastic paper / paper, Optimization and Risks with related topics.
Prerequisites
Reference
1. Books and papers for related topics
Supporting Reference

Course	Course Name : Forecasting Method
	Course Code : KM184821
	Credit : 2
	Semester : 8

Description of Course	
This course provides forecasting methods including the basic quantitative forecasting, basic probability and statistical inference, simple moving average for stationary pattern and linear trend pattern, exponential smoothing for stationary pattern and linear trend pattern, regression method in time series analysis, ACF and PACF plot, ARIMA Box Jenkins method.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
1. Students are able to explain the definition of forecasting 2. Students are able to determine data patterns and trends	

3. Students are able to determine the best forecasting model for time series data
Main Subject
The meaning and benefit offorecasting, basic of quantitative forecasting, basic probability and statistical inference, simple moving average for stationary pattern and linear trend pattern, exponential smoothing for stationary pattern and linear trend pattern, regression method in time series analysis, ACF and PACF plot, ARIMA Box Jenkins method.
Prerequisites
Probability Theory
Reference
1. Andrianto US., Basith A., "Metode dan Aplikasi Peramalan, Jilid 1", Erlangga, Jakarta, 1999 2. Makridakis A. & Wheel Uright, Sc., "Forecasting Methods & Applications", John Wiley and Sons, New York, 1992 3. Wei, WWS., "Time Series Analysis : Univariate and Multivariate Methods", Addison-Wesley Publishing Company, USA, 1990
Supporting Reference
1. Suminto H., "Metode dan Aplikasi Peramalan, Jilid 2", Interaksara, Batam, 2000. 2. Wheelwright Sc, Mc Gee V.G., "Forecasting, 2nd ed.", John Wiley & Sons, Inc, 1983.

Course	**Course Name**	**: Finite Element Methods**
	Course Code	**: KM184822**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
Euler-Lagrange Equation, Ritz Method, Finite Element Method, Galerkin Method, Formation of elements, construction of base functions, Barycentric coordinates, global coordinate assembly.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
Students understand and can solve problems related to the finite element method that is often encountered in science and engineering problems.	
Main Subject	

Euler-Lagrange Equation, Ritz Method, Finite Element Method, Galerkin Method, Formation of elements, construction of base functions, Barycentric coordinates, global coordinate assembly.
Prerequisites
Reference
1. Cuvelier, C., Segal, A & A.A. Steenhoven, 1986. " Finite Element Method and Navier-Stokes Equation", Doordrecht.
Supporting Reference

Course	Course Name : Introduction to Risk Analysis
	Course Code : KM184823
	Credit : 2
	Semester : 8

Description of Course	
This course presents the basics of risk theory, uncertainty, opportunity, opportunity distribution, statistical data, data matching, aggregate distribution, forecasting with uncertainty, correlation modeling, copula, optimization in risk analysis. Presentation of related theories accompanied by discussion of application in the field of insurance and some other fields such as risks to the project, food safety assessment and imported goods.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.4.2	The students are able to review the accuracy of mathematical models and interpret them
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

Course Learning Outcome
1. Students are able to explain concept and methodology in risk analysis theory 2. Students recognize risk models in insurance and other fields. 3. Students are able to use risk models to analyze a risk in insurance and other fields. 4. Students are able to present the results of the analysis using the methods studied for simple problems.
Main Subject
Definition of risk and risk analysis, uncertainty, opportunity, opportunity distribution, statistical data, data matching, Bayesian inferencing, aggregate distribution, and its application to projects, insurance and finance.
Prerequisites
Statistical Methods Probability Theory
Reference
1. Quantitative Risk Analysis, David Vose, Wiley, 2009
Supporting Reference
1. Probability and Risk Analysis, Igor Rychlik and Jesper Ryden, Springer, 2006

Course	**Course Name**	**: Introduction to Computation Fluid Dynamics**
	Course Code	**: KM184824**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
Basic concepts of fluid flow, numerical methods, up to and volume up to fluid flow related, Navier-Stokes equation settlement, fluid flow through complex geometric form, and turbulent flow.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students understand, master and understand the basic concept of fluid flow. 2. Students are able to develop Numerics to solve fluid flow equations. 3. Students are able to understand and solve the Navier-Stokes equation. 4. Students are able to understand the basic concept of turbulence flow.	
Main Subject	

Basic concepts of fluid flow, numerical methods, up to and volume up to fluid flow related, Navier-Stokes equation settlement, fluid flow through complex geometric form, and turbulent flow.

Prerequisites

Reference

1. Anderson, J. D. Jr.,"*Computational Fluid Dynamics (The Basics with Applications), International Edition"*, New York, USA: Mc Graw-Hill, 1995
2. Hoffmann, K. A. and Chiang, S. T.*,"Computational Fluid Dynamics For Engineers"*, Wichita, USA: Engineering Education System, 1995
3. Chung, T.J., "*Computational Fluid Dynamics"*, Cambridge: Cambridge UniversityPress, 2002

Supporting Reference

1. Welty, J.R., et al., *Fundamentals of Momentum, Heat and Mass Transfer, 3rd Edition*, New York, USA: John Wiley & Sons, Inc., 1995
2. Versteeg, H.K. and Malalasekera, W., *An Introduction to Computational Fluid Dynamics – The Finite Volume Method, Second Edition*, England: Prentice Hall - Pearson Education Ltd., 2007.
3. Tu, J.Y., Yeoh, G.H. and Liu, G.Q., *Computational Fluid Dynamics-A Practical Approach*, Oxford, UK: Butterworth-Heinemann Publications, 2008
4. Yeoh, G.H. and Yuen, K.K., *Computational Fluid Dynamics in Fire Engineering*, Oxford, UK: Butterworth-Heinemann Publications, 2009

Course	**Course Name**	**: Numerical Partial Differential Equations**
	Course Code	**: KM184825**
	Credit	**: 2**
	Semester	**: 8**

Description of Course

In this course we will study the methods of solving partial differential equations numerically, either single step or multistep. In addition will also be given a representation of the difference up. The topics related to this course are the completion of partial, elliptical and hyperbolic partial differential equations. Completion of the Elliptical PDP by using the Laplace equation. The completion of the Parabolic PDP uses an explicit scheme and an implicit scheme. The completion of the Hiperbolic PDP uses different schemes and characteristic methods.

Learning Outcome

3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software

Course Learning Outcome

1. Students are able to follow the development and apply math and able to communicate actively and correctly, either oral or written.
2. Students are able to explain the basic principles of Partial Differential Equations consisting of Parabolic PDP, Elliptical PDP and Hiperbolic PDP.
3. Students are able to understand the settlement of PDP by using numerical with several methods.

Main Subject
In this course students will study the following subjects: Definitions of Partial Differential Equations, Parabolic PDP and solutions (explicit and implicit schemes), Eliptic PDPs with their solutions (ADI and SOR schemes) and Hiperbolic PDPs with completion (finite different schemes and characteristic methods).
Prerequisites
Partial Differential Equations Numerical Differential Equations Numerical Method
Reference
1. Steven C. Chapra&Raymond P. Canale, 2010. "Numerical Methods for Engneers 6th edition", McGraw-Hill, Higher Education, Boston, USA. 2. Burden, R.C., Faires J.D. , Reynolds, A.C., 2011, " Numerical Analysis, 9th edition", Brooks/Cole Cengage Learning, Boston.
Supporting Reference
1. Volker John, 2013, "Numerical Methods for Partial Differential Equations", Press, New York 2. Soehardjo, " Refreshing Mathematics ", 1997, ITS, Surabaya

Course	**Course Name**	**: Numerical Differential Equations**
	Course Code	**: KM184721**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
In this course we will study the methods of solving numerical equations in either single step or multistep. In addition, a numerical solution of the differential equation system will also be provided. The topics related to this course are the completion of numerical differential equations with the Euler, Heun, Runge Kutta, Milne and Adam-Moulton Methods.	
Learning Outcome	
3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
Course Learning Outcome	
1. Students are able to follow the development and apply Mathematics and able to communicate actively and correctly, either oral or written 2. Students are able to explain the basic principles of the theory they understand, especially in relation to the completeness of real numbers, convergence, limits and kekontiuan a function 3. Students are able to explain about the significant role of Real Analysis I in related field clusters or other fields 4. Students are able to present an understanding of Real Analysis I independently or in teamwork	

Main Subject
In this course students will study the following subjects: Definitions of Differential Equations, Taylor Methods, Euler Methods, Heun Methods, Runge Kutta Methods, Multistep Methods, Milne Methods, Adams Methods - Moultons, Differential Equations Systems, Different Definitions Hence, Laplace and Poisson Differential Equations, Problems of non-linear boundary values.
Prerequisites
Ordinary Differential Equations Numerical Method
Reference
1. Gerald, C. F. & Wheatley O. P, 2013. " Applied Numerical Analysis 7th edition", Addison Wesley Publishing Company, California. 2. Burden, R.C., Faires J.D. , Reynolds, A.C., 2010, " Numerical Analysis", Brooks/Cole Cengage Learning, Boston.
Supporting Reference
1. Smith, GD, 1986, "Numerical Solution of Partial Differential Equations: Finite Difference Methods", Oxford University Press, New York 2. Soehardjo, " Refreshing Mathematics ", 1997, ITS, Surabaya

Detail of Courses in Computer Science RMK

Course	**Course Name**	**: Algorithm and Programming**
	Course Code	**: KM184202**
	Credit	**: 4**
	Semester	**: 2**

Description of Course	
Algorithms and programming is course that discuss the basic concepts of algorithms and procedural programming. The concepts of algorithm and programming is implemented in JAVA programming language and will be used to solve simple problems. The topic include: basic algorithms, data types, variables, I/O structures, operators, loops, control structures, functions and procedures, array, string manipulation, recursive, GUI and event driven. The teaching system include tutorials, responses and scheduled workshops.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	

1. Be able to understand the basic concepts of algorithms and procedural computer programming. 2. Be able to design algorithms, flow charts, and create computer programs with JAVA language programming to solve mathematical problems, individually or togetherly.
Main Subject
1. Algorithms: definition, criteria, flow chart, pseudo-code 2. Programming Concepts: paradigms, structured programming steps, programming languages 3. Java Programming Language: data types, keywords, constants, variables, I/O structures, operators, loops, control structures, functions and procedures, array, string manipulation, recursive, GUI and event driven.
Prerequisites
Reference
1. Java Programming Comprehensive, 10th edition, Pearson Education, Inc., publishing as Prentice Hall, 2013 2. Paul Deitel, Harvey Deitel, Java: How to Program, 9th edition, Prentice Hall, 2012
Supporting Reference
1. Abdul Kadir, “Algoritma & Pemrograman Menggunakan Java”, Andi Offset, 2012

Course	**Course Name**	**: Object Oriented Programming**
	Course Code	**: KM184303**
	Credit	**: 3**
	Semester	**: 3**

Description of Course	
Object-oriented programming is a course that discusses the basic concepts of object-oriented programming using JAVA programming language. The course include: object-oriented programming concepts, UML diagrams, encapsulation, inheritance, polymorphism, comparable, exception handling, and data structures	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
1. Be able to understand the basic concepts of object-oriented programming 2. Be able to understand and design class diagrams with Unified Modeling Language (UML)	

3. Be able to apply object oriented programming to design and develope a program to solve a problem using JAVA programming language, individually or togetherly
Main Subject
1. OOP: Object-oriented programming paradigm, UML diagram 2. OOP Concepts: encapsulation, inheritance, polymorphism 3. OOP SUPPORTING UTILITIES: comparable and exception handling 4. Data structure: list, stack and queue
Prerequisites
Algorithms And Programming
Reference
1. Y. Daniel Liang, "Java Programming Comprehensive", 10th edition, Pearson Education, Inc., publishing as Prentice Hall, 2013 2. Paul Deitel, Harvey Deitel, "Java: How to Program", 9th edition, Prentice Hall, 2012
Supporting Reference
1. Abdul Kadir, "Algoritma & Pemrograman Menggunakan Java", Andi Offset, 2012 2. C. Thomas Wu, An Introduction to Object-Oriented Programming with Java, 4thEdition, Mc Graw Hill, 2006.

Course	**Course Name**	**: Discrete Mathematics**
	Course Code	**: KM184304**
	Credit	**: 3**
	Semester	**: 3**

Description of Course	
This course deals with set problems, relationships and functions, introductory graphs, recurrence relations, and introductory combinatorics. As a support for the data structure course, graph theory, and combinatorial analysis.	
Learning Outcome	
3.1.3	The students are able to understand the basic methods in mathematics
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
1. The students are able to understand discrete objects, analyze, construct an argument in discrete structure problems, and can apply them to solve discrete structured problems.	

2. The students are able to explain the connection of basic concepts of discrete mathematics with other branches of science.
Main Subject
Discrete sets, operators for discrete sets, inclusion and exclusion principles, basic counting, discrete opportunities. Binary relation and its properties, equivalent relation and partial sorting. Pigeonhole principles, boolean algebra, graph, isomorphism and planar graph, Euler and Hamilton trajectory, tree and cut-set, numerical functions and generating functions, recurrence relation, different equations.
Prerequisites
Reference
1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications" 7th ed., McGraw-Hill, 2011
Supporting Reference
1. Grimaldi, R. P., "Discrete and Combinatorial Mathematics" 5th ed., Addison-Wesley Publ. Co., 2006. 2. Liu, C. L. and DP Mohepatra, "Elements of Discrete Mathematics", 3rd ed., McGraw-Hill Inc., 2008.

Course	Course Name : Mathematical Software
	Course Code : KM184403
	Credit : 3
	Semester : 4

Description of Course	
Mathematical software is a course that provides knowledge, understanding and utilization of softwares those can be used to solve mathematical problems. The softwares include Matlab, Maple, Sage, OpenCV and Geogebra. The teaching system includes tutorials, responses and scheduled workshops.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
1. The students are able to understand how some mathematical software perform calculations 2. The students are able to create programs using a programming language that is part of the software 3. The students are able to understand how to create a graph using software	
Main Subject	

1. Introduction of software and support systems
2. Basic computation
3. Description of internal data and programming
4. 2D and 3D function charts, parametric curves, and parametric surfaces

Prerequisites

Algorithms and Programming
Object Oriented Programming

Reference

1. Getting Started with MATLAB®, Version 7, The MathWorks, Inc., 2005
2. Maple User Manual , Maplesoft,a division of Waterloo Maple Inc. 2014.
3. OpenCV Java Tutorials Documentation,
4. Mathematical Computation with SageMath, Paul Zimmermann, 2017

Supporting Reference

Course	**Course Name**	**: Simulation**
	Course Code	**: KM184506**
	Credit	**: 3**
	Semester	**: 5**

Description of Course	
Provide a theory and practical understanding to students in solving problems that exist in a system (real) through system modeling and system simulation.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
Course Learning Outcome	
1. Able to apply Mathematics thinking framework and computation-based pattern recognition algorithms to solve software development problems and intelligent systems. 2. Able to solve and provide alternative solutions in the problem of pattern discovery in large-scale data with algorithm approaches studied either independently or in teamwork	

3. Students are able to explain the concepts in data mining which include definition, application, process, task in data mining (classification, clustering, association, sequence), and application of Mathematics as tools in DM
Main Subject
1. Simulation and Decision-Making Analysis, 2. Engineering Element Simulation, 3. Development of Simple Simulation Model, 4. Data Collection and Analysis, 5. Random Number Generator And Random Variation, 6. Verification And Validation Model, 7. Output Analysis, 8. Model Optimization
Prerequisites
Statistical Method Probability Theory
Reference
1. Harry Perros, "Computer Simulation Techniques", NC State University publisher, 2009 2. Stewart V. Hoover and Ronal F. Perry, "SIMULATION – A Problem-Solving Approach", Addison-Wesley Publ. Co. Inc., 1989.
Supporting Reference
1. Singh, V.P., "System Modeling and Simulation", New Age International Publisher, 2009 2. Claudius Ptolemoeus, "System Design, Modeling and Simulation", Mountain View California, 2014

Course	**Course Name**	**: Database System**
	Course Code	**: KM184722**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
This course is the basis for software development, both desktop and web based. In the course students are given the understanding and mastery of the concept of database systems, management in storage media, designing and modeling data based on user needs analysis and implement it in a DBMS.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Able to understand and describe the concept of database system 2. Able to understand the concept of data management in storage (storage organizations) 3. Be able to identify and analyze user needs related to data	

4. Able to design and model data with good database structure and implement it in RDBMS
5. Able to understand and implement queries in the database

Main Subject

1. Understanding the basic concepts of database systems
a. Why database is needed
b. Data Viewpoint
c. Instance and schema
d. Database Administration
e. Database Users
2. Able to understand the concept of relational model
a. The Relational Model Concept
b. Constraints and schemes on relational models and Constraint integrity
3. Data modeling using ER Model
a. Data design using Conceptual Data Model
b. Entity, Attribute and Key, Weak entity
c. Examples of other ER diagram notations
d. Mapping ER scheme into a Relational Database Schema.
4. Structured Query Language (SQL)
a. Data Definition Languager (DDL)
b. Data Manipulation Language (DML)
5. Introduction of database design theory and normalization
a. Functional Dependency
b. Normalization

Prerequisites

Object Oriented Programming

Reference

1. Ramez A. Elmasri, Shamkant B. Navathe, "**Fundamentals of Database Systems**", ADDISON WESLEY Publishing Company Incorporated, 2011
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "**DATABASE SYSTEM CONCEPTS, SIXTH EDITION",** McGraw-Hill Companies, 2011

Supporting Reference

1. Ramakrishnan, Raghu, Gehrke, Johannes, Database Management Systems, 3rd Edition, New York: The McGraw-Hill Companies, Inc., 2003

Course	**Course Name**	**: Digital Image Processing**
	Course Code	**: KM184723**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
Image processing is a subject that contains the basic concept of digital image processing and basic algorithms for image processing. Image processing techniques include enhancement, restoration, segmentation, image compression and Mathematics morphology. In addition to this course will also discuss about the science of Mathematics used for image processing, the Fourier transfromasi, and morphological mathematics.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
1. Able to understand the concept and basic techniques of image processing 2. Able to understand the fundamental algorithm and how to implement it with programming language.	

3. Be able to apply the concept for more complex image processing applications individually or in groups.
Main Subject
1. The basic concept of image processing 2. Image enhancement with spatial filtering 3. Image enhancement in the frequency domain 4. Restoration and image reconstruction (image restoration) 5. Morphological image processing 6. Image segmentation (image segmentation) 7. Color image processing 8. Image compression
Prerequisites
Object Oriented Programming Linear Algebra Elementer
Reference
1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Third Edition, Pearson, 2008 2. John C. Russ, "The Image Processing Handbook", Sixth Edition, CRC Press, 2011.
Supporting Reference
1. *Gonzalez, Woods, and Eddins, "Digital Image Processing Using MATLAB (DIPUM)"*, Prentice Hall, 1st edition , 2004

Course	**Course Name**	**: Artificial Intelligence**
	Course Code	**: KM184724**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
Artificial Intelligence is one of the branches of Science related to the use of computers to do the work normally done by humans. This is usually done by following / modeling the characteristics and analogy of thinking of human intelligence, and applying it as an algorithm known by computers. With a more flexible and efficient approach can be taken depending on the needs, which affect how the behavior of artificial intelligence arises.	
Learning Outcome	
3.1.1	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.1.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
3.2.3	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
3.2.4	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.1.4	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.2.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.2.2	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
4.3.2	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system

4.6.2	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system

Course Learning Outcome

1. Students mamapu understand the definition of artificial curiosity, and history of development of artificial intelligence to the latest technology.
2. Students are able to understand how the concept of problem solving with heuristic search
3. Students are able to understand and instruct first-order logic
4. Students are able to understand and solve uncertainty problems through reasoning
5. Students understand the workings of rule-based expert systems, and implement on a small scale
6. Students are able to understand the heuristic method (MH)
7. Students are able to understand Swarm Intelligence method
8. Students are able to understand the concept of Natural Language Processing
9. Students understand practical examples of machine learning (machine learning)

Main Subject

1. History and Development of the present artificial intelligence
2. Method Searching
3. Inference Logic order 1
4. Inference in uncertainty (probabilistic)
5. Rule-based systems and expert systems
6. Heuristic Methods and Swarm Intelligence
7. Natural language processing

Prerequisites

Mathematical Logic

Reference

1. S. Russel and P. Norvig, “Artificial Intelliegence: A Modern Approach 3ed, Penerbit Person Education, 2010

Supporting Reference

1. Ian Millington, “Artificial Intelligencence for games:”, Penerbit Elsevier, 2006
2. Andre Popov, “Genetic Algorithm for Optimization using MATLAB”Penerbit Wolfram, 2005

Course	**Course Name**	**: Data Mining**
	Course Code	**: KM184725**
	Credit	**: 2**
	Semester	**: 7**

Description of Course	
The increasing use of information technology and systems caused the volume of data increase very rapidly. Data mining provides methods and tools to utilize data through the discovery of hidden, interesting, and useful patterns of knowledge from the data. Topics include basic data mining concepts, preprocessing data, classification, clustering, associations, sequence patterns, math applications for data mining, data mining applications: web mining, spatial data mining and so on. Lecture methods include classroom tutorials and discussions. In addition, to train the student's ability in cooperation and communication, will be given a project in the form of problem solving with existing tools in data mining. This project will be completed in groups and given in the end of the lecture. Assessment methods include written evaluation and assessment of the process and documentation of the results of the analysis, design and modeling, and how to present them.	
Learning Outcome	
3.2.2	The students are able to identify problems, create mathematical models and solve them
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.2	The students are able to follow the developments of Science and Technology that support the work field

Course Learning Outcome
1. Students are able to apply mathematical and computational thinking that based on pattern recognition algorithms to support the development of software and intelligent systems. 2. Students are able to solve and provide alternatively solutions in the problem of pattern discovery in large-scale data with data mining algorithm approaches either independently or in teamwork 3. Students are able to explain the concepts of data mining which include KDD process, task in data mining (classification, clustering, association, sequence), and its application
Main Subject
Data Mining concepts, big data, data preprocessing, data mining task: association rule, classification, clustering, sequence pattern, mathematical tools for data mining, application of data mining: web mining, spatial data mining, case study.
Prerequisites
Database Systems
Reference
1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Third Edition, Morgan Kaufmann Publisher, 2012
Supporting Reference
1. Pang Ning Tan, Michael Steinbach, dan Vipin Kumar, Introduction to Data Mining, Addison Wesley, 2006

Course	**Course Name**	**: Design and Analysis of Algorithm**
	Course Code	**: KM184826**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course include how to transform the problem into input, process and output of a program. This course equips ways of designing an algorithm on a problem and performs an analysis of the algorithm created so that it can choose the right algorithm to be implemented into the program. The problems that often arise in computing will be examples of case discussions, such as problems in searching, sorting, matrix operations, graphs, and optimization problems.	
Learning Outcome	
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.2	The students are able to follow the developments of Science and Technology that support the work field
4.7.1	The students are able to apply mathematical abilities to create jobs
Course Learning Outcome	
1. The students are able to solve and provide alternative solutions in programming problems with algorithm approach and data structures, individually or in teamwork 2. The students understand the basics of algorithm design to build a correct and efficient algorithm	

3. The students understand the basics of algorithm analysis, include time computation and memory requirements 4. The students understand and are able to implement graph algorithms. 5. The students understand and are able to implement optimization programming algorithms. 6. The students are able to explain and analyze sorting and searching algorithms and use the appropriate methods 7. The students are able to solve programming problems by utilizing the algorithm and analyze it intelligently and creatively.
Main Subject
Algorithm design, algorithmic analysis, searching, sorting, matrix algorithms, graph algorithms, dynamic programming, Greedy algorithm, evolutionary algorithm and case studies
Prerequisites
Matematika Diskrit Algoritma dan Pemrograman Pemrograman Berorientasi Objek
Reference
1. Sara Baase and Allen Van Gelder,Computer Algorithms: Introduction to Design and Analysis 3rd Ed., Addison-Wesley, 2000. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Cliffortd Stein, Introduction to Algorithms, 3rd ed. , MIT Press, 2009.
Supporting Reference
1. Clifford A. Shaffer, Data Structures and Algorithm Analysis, Java edition, Prentice Hall 2013

COURSE	**Course Name**	**: Software Engineering**
	Code	**: KM184827**
	Credits	**: 2**
	Semester	**: 8**

DESKRIPSI MATA KULIAH

This course discusses the concept and model of object-oriented software development, functional or combination of both (UML) along with the creation of development documentation.

These course materials include the basic concepts of software development, the development phase of the software development (requirement analysis and modeling, system design and modeling, implementation and testing), introduction to software project management.

Lecture methods include tutorials and discussions. In addition, to train student's ability in cooperation and communication, will be given software development projects that will be completed in groups and given in the middle lectures. While assessment methods include written evaluation and assessment of the process and documentation of the results of the analysis, design and modeling, and how to present it.

CAPAIAN PEMBELAJARAN LULUSAN YANG DIBEBANKAN MATA KULIAH

3.1.2	The students are able to identify simple problems, form mathematical models and solve them
3.1.3	The students are able to understand the basic methods in mathematics
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.4.2	The students are able to review the accuracy of mathematical models and interpret them

4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

CAPAIAN PEMBELAJARAN MATA KULIAH

1. Mastering the concept and model of object-oriented software development, functional and combined both (UML) and create software development documentation.
2. Able to complete and provide alternative solutions in software development either with the approach being studied either independently or in teamwork.

POKOK BAHASAN

Introduction: Software vs Software Engineering, software development process, principles in software development, understanding requirement, requirement modeling, modelling with UML/Rational Rose, design concept and modeling, Web Apps Design, software testing, software project management, case study.

PRASYARAT

Object Oriented Programming

PUSTAKA

1. Roger S Pressman, Software Engineering: A Practitioner's approach, 8th ed, McGraw Hill , 2012

PUSTAKA PENDUKUNG

1. Ian Sommerville: Software Engineering, 8th ed, McGraw Hill, 2010

Course	**Course Name**	**: Artificial Neural Network**
	Course Code	**: KM184828**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
The course of artificial neural networks is a course that studies computational algorithms that mimic how biological neural networks work. This course is part of the Data Science, because the algorithm learned works well when applying data processing.	
Learning Outcome	
3.1.1	The students are able to interpret the mathematical basic concepts and arrange the proofs directly, indirectly, or using mathematical induction
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.3	The students are able to analyze systems and optimize their performance
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.2	The students are able to follow the developments of Science and Technology that support the work field
Course Learning Outcome	

1. Students are able to explain in any field the application of ANN
2. Students are able to analyze the simplest ANN algorithm to recognize AND, OR, NAND and NOR logic patterns.
3. Students are able to well explain the different implementation of ANN algorithm with 1 processing element and multi processing element.
4. Students are able to properly explain the network capable of storing memory
5. Students are able to properly explain the basic concepts of competition-based networks and problems that the network can solve
6. Students are able to explain the difference between the concept of backpropagation and varietin network algorithms
7. Students are able to properly examine the scientific work on the ANN application

Main Subject

1. Modeling of artificial neural networks from biological neural networks,
2. A simple pattern recognition with Perceptron, Hebb and Adaline,
3. Character recognition with Percepron, Associative memories,
4. Classification with BP, and LVQ,
5. Clustering with Kohonen SOM,
6. Forecasting BP, and RBF
7. Alternative model of ANN

Prerequisites

Linear Algebra Elementer
Computer Programming

Reference

1. Irawan, M. Isa, “Dasar-Dasar Jaringan Syaraf Tiruan ”, Penerbit ITS Press, 2013

Supporting Reference

1. Laurene Fauset, “Fundamental of Artificial Neural Networks”, Penerbit Prentice Hall, 1994
2. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Penerbit Addison Wesley, 1991

3. Simon Haykin, “Kalman Filtering and Neuralnetwork”, Penerbit John Wiley & Sons, 2001

Course	**Course Name**	**: Fuzzy Logic**
	Course Code	**: KM184829**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
The fundamental idea of the course is to provide basic and concrete concepts of the fuzzy theory and its applications. There are numerous examples, figures, and exercises to help students to understand. This course consists of two parts: a theory part and an application part.	
Learning Outcome	
3.2.1	The students are able to understand the basic mathematical theories, among athers, set theory, function, differential, integral, space and mathematical structure
3.2.3	The students are able to analyze systems and optimize their performance
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.2.2	The students are able to explore, do logical reasoning, generalize, do abstraction, and prove formally
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.2	The students are able to follow the developments of Science and Technology that support the work field
Course Learning Outcome	
1. Students are good at explaining the concept of crisp set in set theory	

2. Students are able to explain the concept of fuzzy set, how relationships and fuzzy membership value mechanism.
3. Students are able to explain the algebra of the fuzzy set (T-norm and T-conorms), Hedges, fuzzy arithmetic, fuzzy reasoning and propositions
4. Students are able to explain the concept of rule based system characteristics, production system, fuzzification and data-system defuzzification. driven, and expert system rule base
5. Students are able to explain the concept of rule based expert system, forward and backward chaining, and overcome the uncertainty in rule based system.
6. Students are able to explain the concept of uncertainty in a rule-based system, a combination of fuzzy numbers and membership, Bayes method and dempster-shafer
7. Students are able to explain data modification and truth value, selection of reasoning type, fuzzification and defuzzification
8. Students are able to explain fuzzy applications for pattern recognition including fuzzy clustering, fuzzy time series, fuzzy pattern recoqnition.
9. Students are able to explain fuzzy decision making, including multi criteria, multi person and multi stage, fuzzy staged decision making, fuzzy ranking method and fuzzy linear programming

Main Subject

Crisp set concepts, fuzzy set concept, fuzzy set relation, fuzzy set operation, rule based inference, fuzzy inference, fuzzy logic, fuzzy decision making

Prerequisites

Mathematical Logic

Reference

1. Kwang H. Lee, " First Course on Fuzzy Theory and Applications", Penerbit Springer Verlag Berlin, 2005

Supporting Reference

1. Zimmerman, "Fuzzy Set and Fuzz Logic", Kluwer Publishing, 1991
2. William Siler and James J. Bookley, "Fuzzy Expert System and Fuzzy Reasoning", Penerbit Wiley and Sons, Inc, 2006
3. George J. Klir dan Bo Yuan, "Fuzzy Set and Fuzzy Logic", Prentice Hall, 1995

Course	**Course Name**	**: Cryptography**
	Course Code	**: KM184830**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
Cryptography is a course that provides the basics of cryptography and digital signatures for data security. The topics include the fundamentals of mathematics, classical and modern cryptographic algorithms, criteria techniques and applications of cryptography. The teaching system includes tutorials, responses and scheduled workshops.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	
The students are able to develop the concepts and procedures of computer security techniques, particularly data and information security, individually and togetherly.	

Main Subject
1. INTRODUCTION OF CRYPTOGRAPHY: basic introduction of cryptography, security data, information theory, complexity and number 2. SOME ENCRYPTIONAL ALGORITHM: classical and modern encryption algorithms (DES and public key algorithms) 3. CRYPTOGRAPHIC TECHNIQUES: some cryptographic techniques, key management
Prerequisites
Discrete Mathematics
Reference
1. William.Stallings, Cryptography and Network Security, Principle and Practise. 2nd ed., Prentice Hall, 1999 2. Douglas R. Stinson, "Cryptography Theory and Practice", 3rd Edition, Chapman & Hall/CRC, 2006
Supporting Reference
1. Serge Vaudenay, "A Classical Introduction to Modern Cryptography', Springer, 2006 2. Rinaldi Munir "Kriptografi", Informatika Bandung

Course	Course Name : Topics in Computing
	Course Code : KM184831
	Credit : 2
	Semester : 8

Description of Course	
In this lecture examines new topics about Computer Science. The paper / paper review on the topic is presented in the form of discussion and presentation It is expected that the topics of the final project will arise.	
Learning Outcome	
3.2.2	The students are able to identify problems, create mathematical models and solve them
4.1.1	The students are able to understand mathematical problems, analyze and solve them
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.1	The students are able to observe, recognize, formulate and solve problems through a mathematical approachs
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Students are able to study new topic about Computer Science 2. Students are able to understand and relay material from paper / related papers in the form of presentation	

Main Subject
Materials on new topics Computer Science, paper / paper Computer Science with related topics.
Prerequisites
Reference
1. Books and paper for related topics
Supporting Reference

Course	**Course Name**	**: Development of Web Application**
	Course Code	**: KM184832**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course provides the understanding and ability to implement programming in relation to the development of web-based applications that are very rapid development. This course covers materials about basic concepts of web-based programming as well as the latest web development technologies such as framework, service-oriented architecture and technology in search engines.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
4.6.1	The students are able to accept and follow new knowledges in accordance with the occupied work field
Course Learning Outcome	
1. Knowing and understanding the infrastructure components in web application development	

2. Able to implement client side programming and server sideserta integrate with databaseuntuk used in web application development
3. Understand and implement framework and content management in web-based application development
4. Provide basic knowledge of Service-Oriented Architecture and API

Main Subject

1. Client-side programming
a. Introduction of environment and infrastructure in relation to web programming
b. HTML5, CSS, forms, JavaScript
2. Server side programming
a. Basic and advanced PHP programming
b. Use of Object Oriented Programming in PHP
c. AJAX and Jquery
3. Integration database with web-based applications
a. Connection management
b. Utilization of session and cookies for authentication
4. MVC and web-responsive architecture
a. MVC
b. Bootstrap framework
5. Service-Oriented Architecture
a. Cloud Services
b. Web Service APIs
c. Personalized search on the World Wide Web
d. Web Crawling
e. Social Web Search

Prerequisites

Object Oriented Programming
Database System

Reference

1. Building Responsive Web Applications AJAX and PHP, Darie, C., et. All., PACKT Publishing Ltd, 2006
2. Building JavaScript, CSS, HTML, and Ajax-Based Applications for iPhone, Android, Palm Pre, BlackBerry, Windows Mobile and Nokia S60, Frederick, R. G., Lal, R. Apress, 2009

3. PHP and MySQL Web Development, Welling, L., Thomson, L., SAMS, 2001

Supporting Reference

1. CSS3 for web designers, Cederholm, D. Jeffrey Zeldman, 2010
2. Web Services Technologies : State of the Art definitions, Standards, Case Study, Albereshine A., Fyhrer P., Pasquier J. 2009
3. HTML5 for web designer, Keith, J., 2010
4. https://getbootstrap.com/

Course	**Course Name**	**: Decision Support Systems**
	Course Code	**: KM184833**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
Decision support system is a course that discusses computerized systems, include knowledge-based/knowledge management systems, that support decision-making within the organization and its supporting components. Decision support system can be described as a system capable of supporting ad hoc data analysis, and decision-making, decision-oriented, future planning orientation.	
Learning Outcome	
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.2	The students are able to analyze phenomenons through a mathematical model and solve it
4.1.3	The students are able to apply a mathematical thinking frameworks to solve optimization problems, both analytically and empirically
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.4.1	The students are able to structurally analyze a systems or problems, reconstruct, and modify them into a mathematical models
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision

4.6.2	The students are able to follow the developments of Science and Technology that support the work field

Course Learning Outcome

1. The students are able to explain the decision-making frameworks in management.
2. The students are able to explain the basic concepts of decision making
3. The students are able to understand the characters and capabilities of decision support systems
4. The students are able to understand the models and analysis in decision support systems
5. The students are able to recognize and understand issues in business intelligence
6. The students are able to explain the Company's information systems and where the decision support system is applied
7. The students are able to explain about knowledge managements
8. The students are able to understand the effects of electronic commerce on decision making
9. The students are able to understand the impacts or influences of the management support system

Main Subject

Management support systems, decision making, systems and support, decision support systems, data management, data modeling and management, user interfaces, building decision support systems, organizations of decision support systems, group decision support systems, executives and their support systems, knowledge and data machines, applications and models of decision support systems.

Prerequisites

Reference

1. Turban, Efraim & Aronson, Jay E., "Decision Support Systems and IntelligentSystems", 8th edition, Prentice Hall, Upper Saddle River, NJ, 2007

Supporting Reference

1. Marakas, George M. “Decision Support Systems in the 21st Century”, 2nd Edition,Prentice Hall, 2003
2. Vicki L. Sauter, Decision Support for Business Intelliegence, John Wiley & Sons, 2010
3. Prague, Ralph, H & Hugh, J. Watson, "Decision Support Systems", Prentice Hall, Inc., 1993

Course	**Course Name**	**: Database Technology**
	Course Code	**: KM144834**
	Credit	**: 2**
	Semester	**: 8**

Description of Course	
This course has a prerequisite database system. In this course students are given an understanding of how the Base Management System will perform processing in the query, perform query optimization with SQL programming so that it can improve the performance of the database. In this matakuiah also explained about the technology and the concept of data base distribution, how to design and query in it. In addition, in this subject is also studied the latest database technologies that include datawarehouse, OLAP and multimedia databases. At the end of the course is also given knowledge about user permissions.	
Learning Outcome	
3.1.4	The students are able to understand the basic concepts of procedural, object-oriented and mathematical programming
3.2.4	The students are able to understand basic concepts and applications of mathematics and computational science to complete the developments of software and intelligent system
4.1.4	The students are able to apply mathematical thinking frameworks and basic computation principles to solve problems in software development and intelligent system
4.2.1	The students are able to develop mathematical thinking, beginning with procedural or computational understanding;
4.3.2	The students are able to observe, recognize, formulate and solve problems through mathematical approachs with the help of software
4.5.1	The students are able to utilize various mathematically problem solving alternatives that are available, independently or in a group to get right decision
Course Learning Outcome	

1. Able to understand the concept of Query processing and transaction processing in the database
2. Able to understand and apply advanced SQL programming to improve database performance perfomansi
3. Able to understand the basic concepts of distributed databases
4. Able to explain and understand the latest database applications, which include data warehouse, OLAP, Spatial database and multimedia database
5. Be able to recognize and explain about securities data base

Main Subject

1. Query processing and transaction processing
a. Evaluate expression
b. Algebraic Relation
c. Implementation of Atomicity and Durability
2. SQL Programming
a. Store procedures and functions, triggers, cursors
b. Trigger in the database
c. View, Error Handling
3. Distributed databases
a. The concept of distributed databse
b. Distributed database architectures
c. Technique of Replication, fragmentation and data allocation
d. Query processing in a distributed database
4. Latest database applications, Dataware house, OLAP, Spatial Database
a. Data Warehouse, OLAP
b. Spatial database
c. Multimedia database
5. Securities in the data base
a. Introduction of security in the database
b. Management privillege
c. SQL Injection

Prerequisites

Database System

Reference

1. Ramez A. Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, ADDISON WESLEY Publishing Company Incorporated, 2011
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, McGraw-Hill Companies, 2011

Supporting Reference
1. R. Ramakrishnan and J. Gehrke, Database Management Systems, 3rd Edition, New York: The McGraw-Hill Companies, Inc., 2003.