LAMPIRAN 3. SILABUS MATA KULIAH

TEE226101

Advanced Statistics

Statistika Lanjut

BASIC INFORMATION	
Course Credit	2 / 100 minutes per Week
Course Type	Required
Prerequisites	Probability and Random Variables; Discrete Mathematics

STUDENT AND LEARNING OUTCOMES

-Fundamental and Engineering Knowledge

-Data and Experiments

-Development of Engineering Solution

Learning Outcomes

LO1 Students are able to explain (Bloom taxonomy level IV) the concept of estimation theory based on samples to characterize the population.

LO2 Students are able to perform hypothesis (Bloom taxonomy level V) testing of a sample and provide a conclusion of the hypothesis test that has been conducted.

LO3 Students are able to explain (Bloom taxonomy level IV) the concept of regression and interpolation.

LO4 Students are able to evaluate (Bloom taxonomy level V) the analysis of variance technique to compare samples of different population.

COURSE DESCRIPTION

In this course, the students study about the concept of inferential statistics to perform estimation on statistical parameters, perform hypotheses testing, and conduct analysis of variance. In addition, the students also learn about how to formulate simple linear and multiple linear regression model based on samples.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Sampling Distribution

1.1 Random Sampling (Review on the concept of Population and Samples)
1.2 The Concept of Statistics as Function of Random Variables
1.3 Introduction of Sample Mean and Sample Variance as an Example of Statistics
1.4 The Concept of Sampling Distribution
1.5 Probability Distribution Model of Sample Mean and its relationship to Central Limit Theorem
1.6 Relationship between Theoretical Mean, Population Mean, and Sample Mean
1.7 Probability Distribution Model of Difference of Two Sample Means
1.8 Probability Distribution Model of Sample Variance and Discussion on Chi-Square Distribution
1.9 t-Distribution
1.10 F-Distribution

2. Estimation Theory

2.1 Introduction to Concept of Inferensial Statistics
2.2 Point Estimate and Unbiased Estimator
2.3 Variance of Point Estimator
2.4 Introduction to the Concept of Interval Estimate
2.5 The Estimation of Mean of the Population based on Sample (Single Sample)
2.6 Error on Point Estimate
2.7 Prediction Intervals
2.8 Estimation of the Difference between mean of two Population based on sample (Two Samples)
2.9 Estimation of Proportion based on Single Sample
2.10 Estimation of the Difference between Two Proportions based on Two Samples.
2.11 Estimation of the Variance of Population based on Sample (Single Sample)
2.12 Estimation of the ratio of two Variance of two population based on Samples (Two Samples)

3. Hypotheses Testing
3.1 Introduction to the concept of Hypotheses
3.2 Testing a Statistical Hypotheses: Null Hypothesis and Alternative Hypothesis
3.3 Error in Hypotheses Testing
3.4 One Tailed Test and Two Tailed Test
3.5 The use of P-Values for Decision Making in Testing Hypotheses
3.6 Hypotheses Testing Concerning Mean of One Population
3.7 Hypotheses Testing Concering Mean of Two Population
3.8 Size of samples in Hypotheses Testing on Mean
3.9 Hypotheses Testing concerning Single Proportion
3.10 Hypotheses Testing concerning Two Proportion
3.11 Hypotheses Testing concerning Variance

4. Simple Linear Regression and Correlation
4.1 Introduction to Linear Regression Model
4.2 Line Fitting Model
4.3 Least Square Method
4.4 Properties of Least Squares Estimation Method
4.5 Inference Concerning the Regression Coefficients
4.6 Prediction
4.7 Analysis of Variance Approach to evaluate quality of linear regression estimate
4.8 Correlation

5. Multiple Linear Regression Model and Non Linear Regression Model
5.1 Introduction
5.2 Estimation of Regression Coefficients
5.3 Linear Regression Model in Matrix Notation (Related to Least Square Approach in Linear Algebra)
5.4 Properties of Least Squares Estimation Method (represented in matrix notation).
5.5 Inferences in Multiple Linear Regression
5.6 Choice of a Fitted Model through Hypotheses Testing
5.7 Categorical or Indicator Variables
5.8 Model Selection and Model Checking
5.9 Cross Validation

6. Analysis of Variance (ANOVA) Technique

REFERENCES

[1] **Probability and Statistics for Engineers and Scientits, Walpole & Myers, 2012, Ninth Edition, Prentice Hall**

[2] DeGroot, Morris, Mark Schervish. (2014). ***Probability and Statistics ,4th Edition*** **(4). England: Pearson Education, Inc.**

TEE226102

Advanced Mathematics

Matematika Lanjut

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Required
Prerequisites	-

STUDENT AND LEARNING OUTCOMES

-Mathematical and Engineering Knowledge

Choose Student Outcome

Choose Student Outcome

Learning Outcomes

LO1 Students are able to explain (Bloom taxonomy level IV) the concept of vectors and matrices as well as matrices operation, able to solve mathematical problems involving vectors and matrices, and able to interpret this concept from geometrical perspective.

LO2 Students are able to explain (Bloom taxonomy level IV) the relationship between the process of solving linear equations with matrix elimination (Gauss elimination, Gauss-Jordan elimination, and LU factorization) and able to solve systems of linear equations using the aforementioned elimination methods.

LO3 Students are able to explain (Bloom taxonomy level IV) the concepts of vector spaces and subspaces, able to interpret this concepts from the geometrical perspective, and able to apply this intuition from the geometrical perspective to solve related problems.

LO4 Students are able to explain (Bloom taxonomy level IV) the concepts of orthogonality and projection as well as able to solve the problems of projecting a vector into a particular subspaces by exploiting both least-square and Gram-Schmidt methods.

LO5 Students are able to explain (Bloom taxonomy level IV) the property of the determinant of a matrix, able to explain how to compute the determinat of a matrix, able to apply determinant to solve invers problems and system of linear equations.

LO6 Students are able to explain (Bloom taxonomy level IV) the concepts of eigenvalues, eigenvectors, and singular value decompositions (SVD), able to explain how to compute eigenvalue decomposition of a square matrix and the SVD of a matrix.

COURSE DESCRIPTION

This course discusses vector and matrix theory, its role as presentations of geometry, and how this theory can be used to solve mathematical model. The mathematical model can generally be formulated based on some engineering problems.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction to Vectors
2. Linear Equations and Gauss Elimination
3. Multiplication and Inverse Matrices
4. LU Factorization
5. Vector Spaces, Subspaces and Column Spaces
6. Rank, Nullspace and Complete Solutions to Ax = b

REFERENCES

1. Introduction to Linear Algebra by Gilbert Strang

2. Linear Algebra and Its Applications by Gilbert Strang
3. Linear Algebra by David Poole

TEE226201

Numerical Computation

Komputasi Numeris

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Required
Prerequisites	Advance mathematics

LEARNING OUTCOMES

LO1 Students are able to solve (Bloom taxonomy level V) mathematical problems using numerical methods.

LO2 Students are able to analyze (Bloom taxonomy level IV) the advantages and disadvantages of different approaches to solve a mathematical problem.

COURSE DESCRIPTION

This course introduces various numerical techniques related to mathematical modelling, including solving linear equations, root solver, eigenproblems, polynomial approximation and interpolation, integration, and differentiation, and differential equations.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Basic Tools of Numerical Analysis

1.1 Systems of Linear Algebraic Equations

1.2 Eigenproblems

1.3 Nonlinear Equations

1.4 Polynomial Approximation and Interpolation

1.5 Numerical Differentiation and Difference Formulas

1.6 Numerical Integration

2. Systems of Linear Algebraic Equations

2.1 Introduction

2.2 Properties of Matrices and Determinants

2.3 Direct Elimination Methods

2.4 LU Factorization

2.5 Tridiagonal Systems of Equations

2.6 Pitfalls of Elimination Methods

2.7 Iterative Methods

3. Eigenproblems

3.1 Introduction

3.2 Mathematical Characteristics of Eigenproblems

3.3 The Power Method

3.4 The Direct Method

3.5 The QR Method

3.6 Eigenvectors

3.7 Other Methods

4. Nonlinear Equations

4.1 Introduction

4.2 General Features of Root Finding

4.3 Closed Domain (Bracketing) Methods

4.4 Open Domain Methods

4.5 Polynomials

4.6 Pitfalls of Root Finding Methods and Other Methods of Root Finding

4.7 Systems of Nonlinear Equations

5. Polynomial Approximation and Interpolation

5.1 Introduction

5.2 Properties of Polynomials

5.3 Direct Fit Polynomials

5.4 Lagrange Polynomials

5.5 Divided Difference Tables and Divided Difference Polynomials

5.6 Difference Tables and Difference Polynomials

5.7 Inverse Interpolation

5.8 Multivariate Approximation

5.9 Cubic Splines

5.10 Least Squares Approximation

6. Numerical Differentiation and Difference Formulas

6.1 Introduction

6.2 Unequally Spaced Data

6.3 Equally Spaced Data

6.4 Taylor Series Approach

6.5 Difference Formulas

6.6 Error Estimation and Extrapolation

7. Numerical Integration

7.1 Introduction

7.2 Direct Fit Polynomials

7.3 Newton-Cotes Formulas

7.4 Extrapolation and Romberg Integration

7.5 Adaptive Integration

7.6 Gaussian Quadrature

7.7 Multiple Integrals

8. Ordinary Differential Equations

8.1 Introduction

8.2 General Features of Ordinary Differential Equations

8.3 Classification of Ordinary Differential Equations

8.4 Classification of Physical Problems

8.5 Initial-Value Ordinary Differential Equations

8.6 Boundary-Value Ordinary Differential Equations

9. One-Dimensional Initial-Value Ordinary Differential Equations

9.1 Introduction

9.2 General Features of Initial-Value ODEs

9.3 The Taylor Series Method

9.4 The Finite Difference Method

9.5 The First-Order Euler Methods

9.6 Consistency, Order, Stability, and Convergence

9.7 Single-Point Methods

9.8 Extrapolation methods

9.9 Multipoint Methods

9.10 Summary of Methods and Results

9.11 Nonlinear Implicit Finite Difference Equations

9.12 Higher-Order Ordinary Differential Equations

9.13 Systems of First-Order Ordinary Differential Equations

9.14 Stiff Ordinary Differential Equations

10. One-Dimensional Boundary-Value Ordinary Differential Equations

10.1 Introduction

10.2 General Features of Boundary-Value ODEs

10.3 The Shooting (Initial-Value) Method

10.4 The Equilibrium (Boundary-Value) Method

10.5 Derivative (and Other) Boundary Conditions

10.6 Higher-Order Equilibrium Methods

10.7 The Equilibrium Method for Nonlinear Boundary-Value Problems

10.8 The Equilibrium Method on Nonuniform Grids

10.9 Eigenproblems

REFERENCES

[1] Joe D. Hoffman, Joe D. Hoffman, Steven Frankel., 2001., Numerical Methods for Engineers and Scientists

[2] Singh, H., Singh, J., Purohit, S.D., & Kumar, D. (2021). Advanced Numerical Methods for Differential Equations: Applications in Science and Engineering (1st ed.). CRC Press. https://doi.org/10.1201/9781003097938

TEE226103

Modelling

Pemodelan

BASIC INFORMATION

Course Credit	**3 / 150 minutes per Week**
Course Type	**Required**
Course Classification	**Basic Science**
Prerequisites	**Undergraduate calculus**

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

Fundamental and Engineering Knowledge **Engineering Design**

Development of Engineering Solution

Learning Outcomes

LO1 Students are able to explain (Bloom taxonomy level IV) first order ODE, find the solutions using Analytical, Graphical,Numerical Methods, integrating factors, variation of parameters, and Undetermined Coefficients.

LO2 Students are able to solve (Bloom taxonomy level V) a constant coefficient second order linear initial value problem with driving terms.

LO3 Students are able to compute (Bloom taxonomy level IV) Fourier coefficients, and find periodic solutions of linear ODEs by means of Fourier series.

LO4 Students are able to utilize Delta functions to model abrupt phenomena, compute the unit impulse response, and express the system response to a general signal by means of the convolution integral (Bloom taxonomy level IV).

LO5 Students are able to find the weight function or unit impulse response and solve constant coefficient linear initial value problems using the Laplace transform (Bloom taxonomy level IV).

LO6 Students are able to calculate eigenvalues, eigenvectors, and matrix exponentials, and use them to solve first order linear systems. Relate first order systems with higher-order ODEs (Bloom taxonomy level IV).

LO7 Students are able to determine the qualitative behavior of an autonomous nonlinear two-dimensional system by means of an analysis of behavior near critical points (Bloom taxonomy level IV).

COURSE DESCRIPTION

Differential equations plays an important role in science and engineering problem as many practical problems can be mathematically The main objective of this course is to help students gain understanding, constructing solution, and inteprenting differetial equations.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. First-order differential equations

1.1 Natural growth, separable equations

1.2 Direction fields, existence and uniqueness of solutions

1.3 Numerical methods

1.4 Linear equations, models

1.5 Solution of linear equations, integrating factors

1.6 Complex numbers, roots of unity

1.7 Complex exponentials; sinusoidal functions

1.8 Linear system response to exponential and sinusoidal input; gain, phase lag

1.9 Autonomous equations; the phase line, stability

1.10 Linear vs. nonlinear

2. Second-order linear equations

2.1 Modes and the characteristic polynomial

2.2 Good vibrations, damping conditions

2.3 Exponential response formula, spring drive

2.4 Complex gain, dashpot drive

2.5 Operators, undetermined coefficients, resonance

2.6 Frequency response

2.7 LTI systems, superposition, RLC circuits.

2.8 Engineering applications

3. Fourier series

3.1 Fourier series

3.2 Operations on Fourier series

3.3 Periodic solutions; resonance

3.4 Step function and delta function

3.5 Step response, impulse response

3.6 Convolution

3.7 Laplace transform: basic properties

3.8 Application to ODEs

3.9 Second order equations; completing the squares

3.10 The pole diagram

3.11 The Transfer function and frequency response

4. First order systems

4.1 Linear systems and matrices

4.2 Eigenvalues, eigenvectors

4.3 Complex or repeated eigenvalues

4.4 Qualitative behaviour of linear systems; phase plane

4.5 Normal modes and the matrix exponential

4.6 Nonlinear systems

4.7 Linearization near equilibria; the nonlinear pendulum

4.8 Limitations of the linear: limit cycles and chaos

REFERENCES

[1] **Edwards, C., and D. Penney. Elementary Differential Equations with Boundary Value Problems. 6th ed. Upper Saddle River, NJ: Prentice Hall, 2003. ISBN: 9780136006138.**

[2] **MIT., Differential Equations., https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/index.htm**

TEE226202

Advanced Optimization Methods

Optimisasi Lanjut

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	**Required**
Course Classification	**Engineering Topics**
Prerequisites	**Advanced mathematics**

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

Development of Engineering Solution **Engineering Design**

Learning Outcomes

LO1 **Students are able to explain (Bloom taxonomy level IV) and solve (Bloom taxonomy level V) unconstrained optimization problems.**

LO2 **Students are able to explain (Bloom taxonomy level IV) and solve (Bloom taxonomy level V) linear programming problems.**

LO3 **Students are able to explain (Bloom taxonomy level IV) and solve (Bloom taxonomy level V) nonlinear constrained optimization problems.**

COURSE DESCRIPTION

This course deals with analitical methods to solve optimization problems which very often appear in engineering. It studies the uncontrained optimization, linear programming, and nonlinear constrained optimization problems.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

PART I: MATHEMATICAL REVIEW

1. Methods of Proof and Some Notation

1.1 Methods of Proof

1.2 Notation

2. Vector Spaces and Matrices

2.1 Vector and Matrix

2.2 Rank of a Matrix

2.3 Linear Equations

2.4 Inner Products and Norms

3.Transformations

3.1 Linear Transformations

3.2 Eigenvalues and Eigenvectors

3.3 Orthogonal Projections

3.4 Quadratic Forms

3.5 Matrix Norms

4. Concepts from Geometry

4.1 Line Segments

4.2 Hyperplanes and Linear Varieties

4.3 Convex Sets

PART IV: NONLINEAR CONSTRAINED OPTIMIZATION

15. Problems with Equality Constraints

15.1 Introduction

15.2 Problem Formulation

15.3 Tangent and Normal Spaces

15.4 Lagrange Condition

15.5 Second-Order Conditions

15.6 Minimizing Quadratics Subject to Linear Constraints

16. Problems with Inequality Constraints

16.1 Karush-Kuhn-Tucker Condition

16.2 Second-Order Conditions

17. Convex Optimization Problems

17.1 Introduction

17.2 Convex Functions

17.3 Convex Optimization Problems

17.4 Semi-definite Programming

18. Algorithms for Constrained Optimization

18.1 Introduction

18.2 Projections

18.3 Projected Gradient Methods with Linear Constraints

18.4 Lagrangian Algorithms

18.5 Penalty Methods

REFERENCES

[1] Edwin K. P. Chong, Stanislaw H. Zak., 2013., An Introduction to Optimization, 4th Edition

[2] Arora, R.K., 2015. *Optimization: algorithms and applications*. CRC Press.

TEE227101

Publication Writing

Penulisan Publikasi

BASIC INFORMATION

Course Credit	2 / 100 minutes per Week
Course Type	Compulsory
Prerequisites	Methodologi dan Etika Penelitian, Seminar 1

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Effective Communication -
- Professional Ethics -

Learning Outcomes (Max. 6)

LO1 Students are able to write formal academic writing in terms of grammar, organization, and vocabulary (Bloom taxonomy level VI).

LO2 Students are able to express the idea in an academic paper in good publication structure (abstract, methodology, etc) (Bloom taxonomy level VI).

LO3 Enter Learning Outcome (Delete this row if this LO is empty)

LO4 Enter Learning Outcome (Delete this row if this LO is empty)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

Publication Writing (Penulisan Publikasi) is a lecture on how to write good publications or thesis focusing on introduction, methodology, results and

analysis/discussion, conclusion and future research. This lecture emphasizes the students to finish their own seminar paper with on-class assignments and take home assignments. To pass this course, the students must (at least) write a manuscript which is ready to be submitted to an international conference or journal. Students are encouraged to submit their manuscript by the end of the course.

Delivery methods

[1] P**aper project**

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. How to Achieve Good Publication
    a. Strategy your research and projects
    b. Managing Your Research Timeline
    c. Choosing Where to Publish
2. Academic Writing: Grammar
3. Academic Writing:
    a. Organization
    b. Vocabulary
4. Referencing & Citing:
    a. References & Bibliographies
    b. Plagiarism
5. Referencing & Citing:
    a. Documenting Sources in within the Text
6. Expressing an Idea in Academic Writing:
    a. Abstract

7. Expressing an Idea in Academic Writing:
    a. Introduction
8. Expressing an Idea in Academic Writing
    a. Methodology
9. Expressing an Idea in Academic Writing
    a. Results
10. Expressing an Idea in Academic Writing
    a. Discussion
11. Expressing an Idea in Academic Writing
    a. Conclusion
12. Discussion on the final project

REFERENCES

[1] T. Hengl and M. Gould, "Rules of Thumb for Writing Research Articles", 2002. Available online: https://webapps.itc.utwente.nl/librarywww/papers/hengl_rules.pdf

[2] H. Glasman-Deal, “Science Research Writing: For Non-Native Speakers of English”, London: Imperial College Press, 2018

[3] S. Howe, “Phrasebook for Writing Papers and Research in English”, Cambridge: The Whole World Company, 2007.

TKU 226101

Science Philosophy

Filsafat Ilmu

BASIC INFORMATION

Course Credit	1 / 50 minutes per Week
Course Type	Compulsory
Prerequisites	Enter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Effective Communication -
- Professional Ethics -

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) concepts of Science Philosophy

LO2

LO3 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

This course studies science philosophy in general

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. Introduction to scientific philosophy
2. Postpositive, critical theory, constructivism
3. Literacy
4. Social entrepreneurship
5. Inter-disciplinary knowledge
6. Global competence
7. Critical thinking
8. Communication skills
9. Creativity and innovation skills
10. Collaboration
11. Scientific philosophy in STEM
12. Values of UGM

REFERENCES

[1] Kuhn, Thomas S. The Structure of Scientific Revolutions. 3rd ed. Chicago, IL: University of Chicago Press, 1996.

[2] Richard Boyd, Philip Gasper & J. D. Trout, The Philosophy of Science, MIT Press, 1999

[3] Hery Santosa, Nilai-nilai ke-UGM-an: makna identitas dan jati diri, Gadjah Mada University Press, 2017.

TEE227111

Electrical Energy Conversion

Konversi Energi Elektrik

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

Learning Outcomes (Max. 6)

LO1	**Students are able to explain (Bloom taxonomy level IV) electrical energy conversion principles**
LO2	**Students are able to analyze (Bloom taxonomy level IV) electrical energy conversion problems**
LO3	

COURSE DESCRIPTION

Students learn about various kinds of energy sources, both non-renewable (fossil energy sources in the form of coal, oil and gas) and new and renewable energy sources such as nuclear, geothermal, water, wind, solar, biomass and electrochemical which can be converted into electrical energy sources and the principle of electrical energy conversion, efficiency, benefits and impacts on the environment.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction
2. Energy Conversion Trend
3. Hydropower and its uses
4. Geothermal energy and its use
5. Biomass energy and its use
6. Nuclear power technology.
7. Coal power and its uses
8. Solar power and its uses
9. Wind power and its uses
10. Discussion of conference paper 1
11. Discussion of conference paper 2
12. Discussion of conference papers 3.

REFERENCES

[1] Power Generation from Coal, IEA Report 2010

[2] Joel Weisman, Eckart L.E., Modern Power Plant Engineering, Prentice Hall , 1985.

[3] Patel M.R, 1999, “Wind and Solar Power System”, CRC Press

[4] Power System Stability and Control, Kundur, McGrawHill 1994

[5] Publications – scientific papers, journals

TEE 227121

Electrical Energy Management

Manajemen Energi Listrik

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution -
- Data, Experiments, and Modelling -

Learning Outcomes (Max. 6)

LO1 Explain (Bloom taxonomy level IV) the general concept of the sustainable energy system

LO2 Analyze (Bloom taxonomy level IV) the energy conservation in commercial building and industry

LO3 Analyze, calculate and improve the energy efficiency and performance of electrical utilities (Bloom taxonomy level IV).

LO4 Analyze (Bloom taxonomy level IV) the optimal operation of power systems

LO5 Analyze (Bloom taxonomy level IV) the optimal planning of power systems

COURSE DESCRIPTION

In this course, students learn the concept of supplying and utilizing electrical energy in the context of sustainable energy. Students need to understand the concepts and methods

to obtain efficient energy supply through optimal system planning and operation. In addition, sustainable energy must also be supported by energy efficiency activities through demand-side management.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers

- Introduction to national issues on Energy Management System (to warrant the national energy sustainability)
- The general concept of the sustainable energy system from the supply-side and demand-side aspect
- Issues on demand-side management (Energy audit, Energy conservation in commercial and industrial building, Energy conservation in Factory)
- Issues on supply-side management (optimal operation and planning)

REFERENCES

[1] Doty, Steven; Turner, Wayne C, Energy Management Handbook (8th Edition), Fairmont Press, Inc., 978-0-88173-707-3 6.

[2] Amlan Chakrabarti, Energy Engineering and management, PHI Publication.

[3] Guide to Energy Management, Barney Capehart; Wayne Turner; William Kennedy' Marcel Dekker. 2005

[4] Daniel S Kirschen, Goran Strbac, Fundamental of Power System Economics. John Wiley & Sons. 2019

TEE227221

Microcontroller-based Systems

Sistem Berbasis Mikrokontroler Lanjut

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris er Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Knowledge
- Engineering Solution

-

-

Learning Outcomes (Max. 6)

LO1 Students analyze (Bloom taxonomy level IV) the concept of embedded systems, microcontroller-based systems and its role in the internet of things infrastructure and internet of things applications

LO2 Students are able to design a program using high level programming language such as C, MicroPython, Lua and execute it on microcontroller to act as node sensor and gateway for supporting internet of things applications (Bloom taxonomy level VI)

LO3 Students are able to utilize modern software development tools to create, simulate, debug and evaluate programs which is targeted on microcontroller (Bloom taxonomy level IV)

LO4 Students are able to design a schematic and PCB layout for microcontroller-based applications (Bloom taxonomy level VI)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

This course discusses about embedded system especially microcontroller-based applications. NodeMCU is selected as microcontroller device platform for developing internet of things applications. Some programming frameworks such as MicroPython, Mongoose OS and Lua are introduced to broaden the solution perspectives. In the end of course, PCB layout design, PCB printing and PCB assembly topics are given to enrich student's abilities on finalizing their solution as commercial products.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction to Microcontroller-based Systems
2. Introduction to NodeMCU
3. NodeMCU with MicroPython
4. NodeMCU with Mongose OS
5. NodeMCU with Lua
6. NodeMCU for IoT Applications
   - MQTT
   - IoT Cloud Platforms
7. Introduction to PCB layout Design
8. PCB Printing and PCB Assembly

REFERENCES

[1] Rui Santos and Sara Santos, "*MicroPython ESP32 and ESP8266*", Facebook Group, 2019.

[2] Erwin Quyang, "*Hands-On ESP8266: Mastering Basic Peripherals*", HandOn Embedded, 2018.

[3] Agus Kurniawan, "*NodeMCU for ESP32 Development*", 2018.

[4] Peter Dalmaris, "*KiCAD like a Pro, 2nd Edition*", Tech Explorations, 2018.

TEE 227112

Power System Analysis

Analisis Sistem Tenaga

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

Learning Outcomes (Max. 6)

LO1 **Students are able to explain (Bloom taxonomy level IV) basic power system modelling**

LO2 **Students are able to analyze (Bloom taxonomy level IV) power systems using load flow calculations**

LO3 **Students are able to analyze (Bloom taxonomy level IV) power systems during fault conditions**

LO4 **Students are able to analyze (Bloom taxonomy level IV) the basic principles of power system economic operations**

LO5 **Students are able to analyze (Bloom taxonomy level IV) the basic principles of power system stability**

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

This course studies the concept of modeling and analysis systems. In the modeling part, students are introduced with the models of generators, transmission lines, and loads. In the analysis part, it is introduced the basic power systems analysis, namely load flow, short circuit, power systems economic, and power system stability.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction

1.1 Introduction to power generation, transmission, and distribution

1.2 AC power equations (P,Q,S)

1.3 System models for generator, transformer, line, and load

2. Network models

2.1 Perunit system (pu)

2.2 Admittance matrix (Ybus)

2.3 Kron reduction

2.4 Impedance matrix (Zbus)

3. Load flow

3.1 Power flow problem

3.2 Power flow solution with Gauss-seidel

3.3 Power flow solution with Newton-Raphson

4. Symmetrical faults

4.1 Symmetrical fault calculation using bus impedance matrix

5. Unsymmetrical faults

5.1 Symmetrical components and network sequence

5.2 Unsymmetrical faults

6. Economic operation of power systems

7. Power system stability

7.1 Stability problem

7.2 Rotor dynamics & swing equation

7.3 Small signal stability

7.4 Numerical solution to swing equation

REFERENCES

[1] [Hadi Saadat, Power System Analysis.
[2] Stevenson W. D., Grainger J. J., Power System Analysis
[3] D.P. Kothari and I.J. Nagrath., Modern Power System Analysis

TEE 227241

Artificial Neural Network and Fuzzy Systems

Jaringan Syaraf Tiruan dan Sistem Fuzzy

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	E Komputasi numeris nter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

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Learning Outcomes (Max. 6)

LO1 Students are able to analyze (Bloom taxonomy level IV) the concept of Neurofuzzy systems and able to apply engineering design

LO2 Students are able to develop engineering and modify methods based on Neural, Fuzzy, and Neurofuzzy (Bloom taxonomy level V)

LO3 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

The students learn about Neural Networks, Fuzzy Systems, and the integration of the two systems. Neural systems consist of neural networks with single-layer and multi-layer architectures, and with guided and unsupervised learning. Fuzzy system consists of fuzzy set theory, fuzzy set operations and relations. The method of designing and applying fuzzy systems is given intensively. The ANFIS system and fuzzy system development are provided as a provision to explore and develop further fuzzy systems.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers

1. Introduction of Artificial Neural Network and Fuzzy Systems
2. Supervised Neural Networks and Unsupervised Neural Networks
3. Deep Learning
4. Application of Deep Learning
5. Basic Systems and Fuzzy Systems
6. ANFIS

REFERENCES

[1] J.-S.R. Jang, C.-T. Sun, E. Mizutani, 1997, Neuro Fuzzy and Soft Computing, Prentice-Hall Int., Inc.

[2] L. Fausette, 1994, Fundamentals of Neural Network, Prentice Hall, Englewood Cliffs, NJ.

[3] A. P. Engelbrecht, 2007, Computational Intelligence, John Wiley & Sons LTd. England.

TEE227115

Switch Mode Power Supply

Catu Daya Tersaklar

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modeling

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) topologies and working principles of switching mode power supplies.

LO2 Students are able to explain (Bloom taxonomy level IV) the snubber circuits.

LO3 Students are able to explain (Bloom taxonomy level IV) the principle of soft switching.

LO4 Students are able to design magnetic components (inductor or transformer) for switching mode power supplies (Bloom taxonomy level VI).

LO5 Students are able to model switching mode power supplies and design their control system (Bloom taxonomy level VI).

COURSE DESCRIPTION

In this course, the students learn about switch mode power supplies. In the beginning, converter topologies without and with electrical isolation are introduced. Next, methods for reducing losses of converters are explained. The course also covers design of magnetic components such as an inductor or a transformer. Lastly, students learn how to model a power electronic circuit and how to design a control system for a converter.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction

1.1. Linear vs switch-mode power supplies

1.2. Overview of switching power supplies

2. dc-dc Switch-Mode Converters

2.1. Introduction

2.2. Step-down (buck) converter

2.3. Step-up (boost) converter

2.4. Buck-boost converter

2.5. Full-bridge dc-dc converter

2.6. Comparison of dc-dc converters

3. dc-dc Switch-Mode Converters with Electrical Isolation

3.1. Introduction

3.2. Unidirectional vs bidirectional core excitation

3.3. Flyback converter

3.4. Forward converter

3.5. Push-pull converter

3.6. Half-bridge converter

3.7. Full-bridge converter

4. Snubber Circuits

4.1. Turn-on snubber

4.2. Turn-off snubber

4.3. Circuit combinations

4.4. Loss calculations

5. Soft Switching

5.1. Introduction
5.2. Classification of resonant converters
5.3. Basic resonant circuit concept
5.4. Load-resonant converters
5.5. Zero-voltage and zero-current switchings

6. Design of Magnetic Components

6.1. Core shapes and dimensions
6.2. Inductor design
6.3. Transformer design

7. Modeling and control of power electronic converters

7.1. Modeling of a half-bridge converter
7.2. Hysteresis control of the half-bridge converter
7.3. Pulse width modulation (PWM) of the half-bridge converter
7.4. Development of a dynamic converter model
7.5. Basic principle of control
7.6. Control of half-bridge converter
7.7. Modeling and control of a half-bridge converter with LC filter

REFERENCES

[1] Mohan, N., Undeland, T. M., & Robbins, W. P. (1995). Power electronics: Converters, applications, and design. United States of America: John Wiley & Sons.

[2] Hurley, W.G., Wölfle, W.H. (2013). Transformers and inductors for power electronics: theory, design, and applications. United Kingdom: John Wiley & Sons.

[3] Kazimierczuk, Marian K. (2008). Pulse-width modulated dc-dc power converters. United Kingdom: John Wiley & Sons.

TEE 227114

Power System Dynamic and Stability

Dinamika dan Stabilitas Sistem Tenaga Listrik

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Power System Analysis, Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

Learning Outcomes (Max. 6)

LO1 Analyzing fundamental dynamic behaviors of an interconnected power system (Bloom taxonomy level IV)

LO2 Being capable of modeling dynamics and control of major equipment affecting power system stability (Bloom taxonomy level IV)

LO3 Being capable of analyzing problems pertinent to power system transient and small signal stability (Bloom taxonomy level IV)

LO4 Enter Learning Outcome (Delete this row if this LO is empty)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

This course studies dynamic behavior of power systems during faults. At first, the students are given the definition and physical intepretation of power system stability phenomenon. Then, basic modelling of power system components pertinant to power system stability such as synchronous generators, transmission lines, control systems are given. In the last part of the course, students performs stability studies such as transient and small signal stability studies

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. **Reviews of mathematics and control systems**
   1.1. State-space
   1.2. Linearization
   1.3. ODE
2. **Reference frame theory**
   2.1. Types of reference fram
   2.2. Transformation among reference frames
   2.3. Reference frame application for simple circuits
3. **Synchronous generator models**
   3.1. Model in ABC frame
   3.2. Model in dq0 framce
   3.3. Swing equations

3.4. Steady-state calculations
3.5. Parameters of synchronous machine
3.6. Implementing synchronous machine model in Matlab

4. **Transmission line models**
   4.1. Types of tranmission line models and the characteristics
   4.2. Steady-state model
5. **Excitation system model**
   5.1. Types of excitation systems
   5.2. Power system stabilizer
6. **Frequency and active power controls**
   6.1. Prime mover and swing equations
   6.2. Frequency response charancteristics
   6.3. Multi-area operation
   6.4. AGC
7. **Transient stability**
   7.1. Equal-area criterion
   7.2. Numerical solution to generator models
   7.3. Energy functions
8. **Small signal stability**
   8.1. Eigen properties
   8.2. Small signal stability of single-machine to innfinity bus
   8.3. Effects of excitation and PSS

REFERENCES

[1] P.M. Anderson and A.A. Fouad, Power System Control and Stability, John Wiley & Sons, Inc, 2003.
[2] P. S. Kundur, Power System Stability and Control, McGraw-Hill Professional, 1994.
[3] E. W. Kimbark, Power System Stability, Wiley-IEEE, 1995.
[4] J. W. Bialek, J. Machowski, Power System Dynamics and Stability, John Wiley, 1997.
[5] P. W. Sauer, M. A. Pai, Power System Dynamics and Stability, Prentice Hall,1998.
[6] K. R. Padiyar, Power System Dynamics: Stability and Control, John Wiley, 1996.
[7] L. L. Grigsby, Power System Stability and Control, Taylor & Francis, 2007.

TEE 227222

Electronic System Design

Perancangan Sistem Elektronika

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective for SIE
Prerequisites	Enter Komputasi numeris Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Design of simple analog electronic system or circuit (Bloom taxonomy level VI).

LO2 Design of simple digital system (Bloom taxonomy level VI).

COURSE DESCRIPTION

The course will teach a student how to go from a project idea to a fully functional prototype implementation. This involves a simulation software, and printed circuit design using PCB CAD software, and development boards. This Course divided into two part, analog and digital circuits.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers

1. Practical op-amp
2. Frequency response of an op-amp
3. General linear application
4. Active filter and oscillator
5. Comparator and converter
6. Spesialized IC application
7. Selected IC system project
8. Reviews of logic gates
9. Arithmetic circuits
10. Combinatorial circuits
11. Flip-flop, Register, and Counter
12. Syncronous sequential circuit
13. Asyncronous sequential circuit
14. Digital system design

REFERENCES

[1] Ramakant A. Gayakwat, “Op amp and linear integrated circuits”, 4th ed., Pearson Publication Prentice Hall, 2016

[2] Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th ed., McGraw Hill, 2016.

[3] Stephen Brown, Zonko Vranesic “Fundamental of Digital Logic with VHDL Design”, McGraw Hill, 2009.

TEE 227223

Instrumentation Electronics

Elektronika Instrumentasi

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective for SIE
Prerequisites	Enter P Komputasi numeris rerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

-

-

Learning Outcomes (Max. 6)

LO1 Analyze (Bloom taxonomy level IV) the quality of measurement

LO2 Able to design (Bloom taxonomy level VI) electronics instrumentation circuits

COURSE DESCRIPTION

This course teaches students to be able to design instruments for measurement. After completing this course, students are expected to be able to design instrumentation circuits, both at the operational amplifier level and at the transistor level.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers these topics

1. **Introduction to Electronic Instrumentation**
   This is a premiere containing an introduction to the science of measurement and electronic instrumentation. This course studies the quality of measurement and the design of measurement instruments according to the appropriate specifications.
2. **Sensors and Transducers**
   This topic is about Sensors and Transducer, covered in this topic are:
   - Sensitivity and Cross-sensitivities
   - Resistive transducers
   - Capacitive transducers
3. **Errors and Noise**
   this topic discusses the errors and the noise in electronic instrumentations with following subjects:
   - Deterministic and Random Errors
   - Common-mode Rejection Ratio
   - Power supply Rejection Ratio
   - Gain error
4. **Amplifier and Common Mode Signal**
   In this topic the advantages of using differential amplifiers are discussed. Including its respones to common-mode signals.
5. **Modulation techniques for Measurement**
   This topic discusses modulation techniques, which are consist of these subjects:
   - synchronous demodulation
   - lock-in amplification
   - chopping/square-wave modulation
6. **Coherent Detection**
   This topic discusses coherent detection, which contains these subjects:
   - Basic principle (time domain)
   - Amplitude and Phase measurement

- Signal-to-Noise Ratio (frequency domain)
- Switching detector (choppers).

7. **Improvement of measurement systems**

   This topic is about the improvement of the measurement system by improving the information quality. Which can be achieved by:
   - Filtering (averaging) and shielding
   - Compensation (e.g. feed-forward)
   - Correction (e.g. auto-zeroing)
   - Feedback
   - Modulation and correlation

8. **Enabling technologies**

   This topic provides an overview of important technologies enabling the development of test and measuring instruments.

9. **Data Converters**

   This topic provides an overview of design concepts and application guidelines for systems using modern analogue/digital and digital/analogue converters implemented on monolithic chips.

10. **Electronics Counters**

    This topic discusses Basic concepts related to the electronic counters which can be used to measure frequency, time, phase, frequency ratio, time interval average, etc

11. **Circuits for Electronics Instrumentation**

    This topic is concerned with the electronic circuits which are found in instrumentation systems.

12. **Comparator Circuits**

    This topic iintroducing various type of comparator ccircuits which are found in instrumentation systems.

13. **Wide-Band Amplifier Circuits**

    This chapter will concentrate on one small area in the field of wide-band amplifier circuit design: wide-band direct-coupled amplifiers. These are needed for the deflection amplifiers of the conventional analog oscilloscope:

14. **Waveform generator circuits**

    This topic studies waveform generator at the simplest level, which consist of:
    - Sinus wave generator
    - Triangle waveform generator
    - Square wave generator

REFERENCES

[1] Wolffenbuttel, R. F., "Electronic Instrumentation", TU Delft, 2005.

[2] Wu, Rong., Huijsing, J.H. , and Makinwa, K.A.A, "Precision Instrumentation Amplifiers and Read-Out Integrated Circuits", Springer, 2013

[3] Kularatna, Nihal, "Digital and Analogue Instrumentation", IET, 2013

[4] O'Dell, T. H., " Circuits for Electronic Instrumentation", Cambridge Univ. Press, 1991

TEE 227118

Renewable Energy Integration in Power Systems

Integrasi Energi Terbarukan dalam Sistem Tenaga

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students able to explain the variable renewable energy (VRE) characteristic (Bloom taxonomy level IV)

LO2 Students able to explain the issues related to VRE in islands power system (Bloom taxonomy level IV)

LO3 Students able to explain the forecasting of variable renewable energy for grid operations (Bloom taxonomy level IV)

LO4 Students able to analyze the need of power system flexibility requirement (Bloom taxonomy level IV)

LO5 Students able to analyze the impact of VRE penetration on power system operation (Bloom taxonomy level IV)

LO6 Students explain the enabling and disruptive technologies for renewable integration (Bloom taxonomy level IV)

COURSE DESCRIPTION

The students learn about several issues related to integrating variable renewable energy in power systems in general and problems surrounding VRE penetration in archipelagic systems such as in Indonesia. In the early stages, students need to study the characteristics of the VRE and its impact on system operation. In addition, students also need to understand the need for system flexibility to accept large-scale VRE penetration. Finally, it is necessary to know what type of technology can be chosen to increase system flexibility with disruptive technology.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers :

1. Variable Energy Resources in Island Power Systems
2. Intermittency characteristic of variable renewable energy
3. Forecasting variable renewable energy for grid operation
4. Long-Term Energy Systems Planning: Accounting for Short-Term Variability and Flexibility
5. The Role of Power System Flexibility
6. Impact of VRE on power system operation
7. Enabling and disruptive technologies for VRE integration

REFERENCES

[1] Lawrence E Jones. Renewable Energy Integration: Practical management of variability, uncertainty, and flexibility in Power Grids. Academic Press, 2014.

[2] Infield, D. and Freris, L., 2020. *Renewable energy in power systems*. John Wiley & Sons.

TEE227116

Motor Control Inverter

Inverter Pengendali Motor

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to distinguish (analyze-Bloom IV) synchronous-asynchronous motor control requirements.

LO2 Students are able to build (Creating -Bloom VI) a digital control mechanism for a selected motor.

COURSE DESCRIPTION

In this course, students will learn how to control electric motors using a three-phase inverter with the space-vector-control modulation scheme and digital control solution.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers:

1. knowledge of basic asynchronous-synchronous motor characteristics,
2. three-phase inverter structure (2-levels, multilevels).
3. Space Vector Modulation scheme and realization.
4. clarke-park transforms.
5. Digital control realization.

REFERENCES

[1] Mohan, N., Undeland, T. M., & Robbins, W. P. (1995). Power electronics: Converters, applications, and design. New York: Wiley.

[2] Neapolitan, R.E., & Hee Nam, K. (2018). AC Motor Control and Electrical Vehicle Applications (2nd ed.). CRC Press. https://doi.org/10.1201/9781315200149

TEE 227234

Digital Communication

Komunikasi Digtal

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Fundamental of Engineering Knowledge
- Development of Engineering Solution
-
-

Learning Outcomes (Max. 6)

LO1 The students are able to evaluate (Bloom taxonomy level V) the important aspect in the relationship between signal and its representation in frequency domain and its role in communication system.

LO2 The students are able to examine and analyze (Bloom taxonomy level IV) the baseband digital signalling and communication system in baseband level.

LO3 The students are able to analyze (Bloom taxonomy level IV) the principal work and performance of various
baseband digital modulation and demodulation techniques.

LO4 The students are able to evaluate and examine (Bloom taxonomy level V) the communication system performance and link budget analysis

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

] Enter Learning Outcome (Delete this row if this LO is empty)

O6

COURSE DESCRIPTION

The students learn about the review on the relationship between signal and its representation in frequency domain (which is the spectrum). The students then continue by studying the digital communication system at baseband level where they will learn about review on sampling theory, pulse amplitude modulation, pulse code modulation, digital signalling, line codes and spectra, pulse shaping, and the resulting intersymbol interference. The students then learn about digital baseband communication system where they will study about various digital modulation and demodulation technique. Finally, the students will evaluate the communication system performance by first understanding the randomness nature of the signal and noise.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers ….

1. Review on signal and spectrum, and some concepts on random signal processing such as power spectral density and correlation.

2. Baseband pulse and digital signalling, which includes sampling theory and how it affect signal representation in both time and frequency domain, pulse amplitude modulation, pulse code modulation, digital signaling (binary and multilevel signalling), line codes and spectra, intersymbol interference, differential pulse code modulation, and delta modulation.

3. Bandpass digital communication, which includes various digital modulation and demodulation techniques (BPSK, QPSK, QAM and M-ary PSK, etc)

4. Review on random signal processing (required to evaluation communication system performance)

5. Link budget analysis

6. Digital communication system performance evaluation

REFERENCES

[1] Couch, L.W. Digital and Analog Communication System, 8th edition. Pearson, 2013.

[2] Sklar, B. Digital Communications: Fundamentals and Applications, Prentice Hall, 2010.

[3] Proakis, J.G. and Salehi, M. Digital Communications, 5th edition. Mc Graw Hill 2008.

TEE 227233

Advanced Data Communications

Komunikasi Data Lanjut

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	E Komputasi numeris nter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

-

-

Learning Outcomes (Max. 6)

LO1 Explain the general concept of the advanced data communications (Bloom taxonomy level IV)

LO2 Explain analog and digital modulation systems (Bloom taxonomy level IV)

LO3 Able to design and analyze a digital communication systems (Bloom taxonomy level VI)

LO4 Able to analyze the comprehensive of digital communications using simulation software (Bloom taxonomy level IV)Enter Learning Outcome (Delete this row if this LO is empty)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

In this course, students learn the concept of advanced data communications. Students need to understand the basic concepts of analog and digital communications. In addition, simulation is provided to analyze and design analog and digital communication systems.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers

1. Signal and systems in communication systems, propagation model, orthogonal signals, bi-orthogonal signals, Fourier representation of signal
2. Noise and AWGN
3. Formating and baseband modulation
4. Bandpass modulation and demodulation, eye diagram
5. Statistic overview and random process in communications
6. Multiple access in digital communications
7. Spread spectrum: DSSS and FHSS

REFERENCES

[1] B. Sklar, Digital Communications: Fundamental and Applications, Prentice Hall, 2010.

[2] Ha H. Nguyen and Ed Shwedy, A First Course in Digital Communications, Cambridge University Press, 2009.

[3] Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems using MATLAB, PWS Publishing Company, 1998.

TEE227111

Electrical Energy Conversion

Konversi Energi Elektrik

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

Learning Outcomes (Max. 6)

LO1 **Students are able to explain** (Bloom taxonomy level IV) **electrical energy conversion principles**

LO2 **Students are able to analyze** (Bloom taxonomy level IV) **electrical energy conversion problems**

LO3

LO4

LO5

LO6

COURSE DESCRIPTION

Students learn about various kinds of energy sources, both non-renewable (fossil energy sources in the form of coal, oil and gas) and new and renewable energy sources such

as nuclear, geothermal, water, wind, solar, biomass and electrochemical which can be converted into electrical energy sources and the principle of electrical energy conversion, efficiency, benefits and impacts on the environment.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction
2. Energy Conversion Trend
3. Hydropower and its uses
4. Geothermal energy and its use
5. Biomass energy and its use
6. Nuclear power technology.
7. Coal power and its uses
8. Solar power and its uses
9. Wind power and its uses

10. Discussion of conference paper 1

11. Discussion of conference paper 2

12. Discussion of conference papers 3.

REFERENCES

[1] Power Generation from Coal, IEA Report 2010

[2] Joel Weisman, Eckart L.E., Modern Power Plant Engineering, Prentice Hall , 1985.

[3] Patel M.R, 1999, “Wind and Solar Power System”, CRC Press

[4] Power System Stability and Control, Kundur, McGrawHill 1994

[5] Publications – scientific papers, journals

TEE 227232

Radar Signal Processing

Pengolahan Isyarat Radar

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	E Komputasi numeris nter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Fundamental of Engineering Knowledge
- Data, Experiments, and Modelling
-
-

Learning Outcomes

LO1 **Students are able to analyze and explain the radar concept and radar signal models** (Bloom taxonomy level IV)

LO2 **Students are able to analyze and construct numerical simulation of pulse and continuous wave radar signal processing** (Bloom taxonomy level IV)**.**

LO3 **Students are able to demonstrate and examine the target detection process on radar data** (Bloom taxonomy level IV)

LO4 **Students are able to evaluate the recent radar technology** (Bloom taxonomy level V)

COURSE DESCRIPTION

This course delivers the concept and implementation of radar signal processing by including the signal model, preprocessing, and target detection.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. **Introduction to radar**: basic principle, system components, and radar classifications.
2. **Signal models**: radar equation, radar cross-section, clutter, noise, interference, Doppler shift.
3. **Pulsed radar signal processing**: range ambiguities, Doppler sampling, quadrature receiver.
4. **Radar waveforms**: matched filter, pulse compression, continuous wave.
5. **Doppler processing**: Moving Target Indication, Pulse Doppler Processing.
6. **Continues wave radar signal processing**: FMCW, FMICW, Doppler processing.
7. **Target detection:** hypothesis testing, detection threshold, CFAR.
8. **Measurements and tracking:** estimator properties, range, Doppler, and angle estimator, target tracking
9. **Radar antenna and beamforming:** antenna types, spatial beamforming, STAP.
10. **Recent radar technology:** MIMO radar, cognitive radar.

REFERENCES

[1] Richards, Mark A., Fundamentals of Radar Signal Processing: Second Edition, McGraw-Hill Education, 2014,

[2] Skolnik, Merril I., Introduction to Radar Systems: Third Edition, McGraw-Hill Book Co.,2002.

TEE227101

Publication Writing

Penulisan Publikasi

BASIC INFORMATION

Course Credit	2 / 100 minutes per Week
Course Type	Compulsory
Prerequisites	Seminar 1

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Effective Communication
- Professional Ethics

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Learning Outcomes (Max. 6)

LO1 Students are able to write formal academic writing in terms of grammar, organization, and vocabulary (Bloom taxonomy level VI).

LO2 Students are able to express the idea in an academic paper in good publication structure (abstract, methodology, etc) (Bloom taxonomy level VI).

LO3 Enter Learning Outcome (Delete this row if this LO is empty)

LO4 Enter Learning Outcome (Delete this row if this LO is empty)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

Publication Writing (Penulisan Publikasi) is a lecture on how to write good publications or thesis focusing on introduction, methodology, results and analysis/discussion, conclusion and future research. This lecture emphasizes the students to finish their own seminar paper with on-class assignments and take home assignments. To pass this course, the students must (at least) write a manuscript which is ready to be submitted to an international conference or journal. Students are encouraged to submit their manuscript by the end of the course.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. How to Achieve Good Publication
    a. Strategy your research and projects
    b. Managing Your Research Timeline
    c. Choosing Where to Publish
2. Academic Writing: Grammar
3. Academic Writing:
    a. Organization
    b. Vocabulary

4. Referencing & Citing:
    a. References & Bibliographies
    b. Plagiarism
5. Referencing & Citing:
    a. Documenting Sources in within the Text
6. Expressing an Idea in Academic Writing:
    a. Abstract
7. Expressing an Idea in Academic Writing:
    a. Introduction
8. Expressing an Idea in Academic Writing
    a. Methodology
9. Expressing an Idea in Academic Writing
    a. Results
10. Expressing an Idea in Academic Writing
    a. Discussion
11. Expressing an Idea in Academic Writing
    a. Conclusion
12. Discussion on the final project

REFERENCES

[1] T. Hengl and M. Gould, "Rules of Thumb for Writing Research Articles", 2002. Available online: https://webapps.itc.utwente.nl/librarywww/papers/hengl_rules.pdf

[2] H. Glasman-Deal, “Science Research Writing: For Non-Native Speakers of English”, London: Imperial College Press, 2018

[3] S. Howe, “Phrasebook for Writing Papers and Research in English”, Cambridge: The Whole World Company, 2007.

TEE 227122

Microgrid System Design, Operation, and Control

Perancangan, Operasi dan Pengendalian Microgrid

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to design microgrid (Bloom taxonomy level VI)

LO2 Students are able to determine different operating conditions for microgrid (Bloom taxonomy level IV)

LO3 Students are able to distinguish different control structure for microgrid (Bloom taxonomy level IV)

COURSE DESCRIPTION

The students learn about the design, operation, and control of microgrid system.

TOPICS

This course covers introduction to microgrid architecture, control, and operation; study of control strategies of power electronics in microgrid; smart grid and power quality issues;

techno-economic feasibility analysis; distributed generation plant; Fault currents and electrical protection

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

REFERENCES

[1] Jenkins, Nick; Ekanayake, Janaka; Strbac, Goran: *Distributed Generation* (Energy Engineering, 2010)

[2] Fathima, Hina; et. al: *Hybrid-Renewable Energy Systems in Microgrids* (Woodhead Publishing, 2018)

TEE 227217

Statistical Signal Processing

Pengolahan Isyarat Statistis

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris Enter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modeling

-

-

Learning Outcomes (Max. 6)

LO1 Students are able to understand, explain, and apply about Signal Statistical Properties, Signal Statistical Processing in Time Domain, Spatial Domain, and Frequency Domain (Bloom taxonomy level IV).

LO2 Students are able to design and analyze systems based on statistical signal processing (Bloom taxonomy level VI)

LO3 Enter Learning Outcome (Delete this row if this LO is empty)

LO4 Enter Learning Outcome (Delete this row if this LO is empty)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

The Statistical Signal Processing course is an elective course that discusses the Basic Concepts and Methods of Signal Statistical Processing, which includes: Introduction and Scope, Statistical Properties of Signals, Statistical Signal Processing in the Time, Frequency, and Spatial Domains, First Order Signal Statistical Characteristics , Second Order Signal Statistical Characteristics, Detection Theory and Estimation Theory, SSP for Identification and Modeling, SSP for Classification and Recognition, Design and Analysis of SSP-Based Systems

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers

1. Introduction to SSP
2. Statistical Properties of Gestures
3. Statistical Characteristics of Gestures
4. Detection and Estimation
5. SSP for Identification and Modeling

6. CNS for Classification and Recognition

7. Design and Analysis of SSP-Based Systems

REFERENCES

[4] Trevor Hastie, Robert Tibshirani, Jerome Friedman, 2008, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, Springer

[5] Steven M. Kay, 1993,” Fundamentals of Statistical Signal Processing: Estimation Theory”, Prentice Hall International, Inc.

TEE 227242

Autonomous Robots

Robot Otonom

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris Enter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

-

-

Learning Outcomes (Max. 6)

LO1 Students are able to explain various mathematical representations of mobile robots' position and orientation such as Euler angle, quaternion, homogeneous transformation, etc. (Bloom taxonomy level IV)

LO2 Students are able to explain the kinematic model of wheeled mobile robots. (Bloom taxonomy level IV)

LO3 Students are able to explain how the robot perceives the environment and uses sensory data to perform localization and mapping. (Bloom taxonomy level IV)

LO4 Students are able to explain various approaches to mobile robot path planning, navigation, and trajectory tracking. (Bloom taxonomy level IV)

LO5 Students are able to analyze these concepts to program an autonomous mobile robot in realistic settings. (Bloom taxonomy level IV)

LO6

COURSE DESCRIPTION

Students will learn about the fundamentals of mobile robotics, studying the mechanisms that allow a mobile robot to move through a real world environment to perform its tasks. The topics covered include locomotion, sensing, localization, and motion planning. The course synthesizes materials from various fields such as kinematics, control theory, computer vision, artificial intelligence, and probability theory.

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Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. Introduction to Mobile Robotics
2. Mathematical Representation and Configuration Space
3. Robot Locomotion
4. Mobile Robot Kinematics
5. Perception
6. Mobile Robot Localization
7. Path Planning
8. Robot Navigation
9. Control and Trajectory Generation

10. Robot Learning

REFERENCES

[1] Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, MIT Press, 2011

[2] Choset, Howie M. 2005. Principles of robot motion: theory, algorithms, and implementation. Cambridge, Mass: MIT Press.

[3] Corke, Peter. Robotics, Vision and Control - Fundamental Algorithms in MATLAB®. Vol. 73. : Springer, 2011.

[4] Thrun, S., Burgard, W., Probabilistic Robotics, MIT Press, 2005

TEE 227243

Modern Robotics

Robotika Modern

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Numerical Methods Control System Engineering (recommendation)

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
- Analitical methods
- Engineering Design

Learning Outcomes (Max. 6)

LO1 Students are able to compute rigid body transformation, velocity, screw motion, twist and wrenches (Bloom taxonomy level IV)

LO2 Students are able to analyze robot forward and inverse kinematics (Bloom taxonomy level IV)

LO3 Students are able to compute robot dynamics using Euler-Lgrange formalism as well as apply Newton-d'Alembert priciple of virtual work (Bloom taxonomy level IV)

LO4 Students are able to evaluate concept of stability (Bloom taxonomy level V)

LO5 Students are able to design simple controller for unconstrained manipulator (Bloom taxonomy level VI)

LO6

COURSE DESCRIPTION

In Industrial Revolution 4.0 robots is increasingly important. Robots are used from the simple pick and place and painting and welding robots, to more sophisticated assembly robots for inserting integrated circuit chips onto printed circuit boards, to mobile carts for parts handling and delivery and many more. Robotic automation has been standard in Industries and many advanced technological areas sucah as for application in hazardous environments, minimally invasive surgery, and microelectro-mechanical mechanisms. In this class, we discuss kinematics, dynamics, and control of robot manipulators extensively.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction

2 Rigid Body Motion
1 Rigid Body Transformations .
2 Rotational Motion in R3 .
2.1 Properties of rotation matrices .
2.2 Exponential coordinates for rotation .
2.3 Other representations .
3 Rigid Motion in R3 .
3.1 Homogeneous representation .
3.2 Exponential coordinates for rigid motion and twists
3.3 Screws: a geometric description of twists .
4 Velocity of a Rigid Body .

REFERENCES

[1] Murray, Richard M., Zexiang Li, and S. Shankar Sastry. *A mathematical introduction to robotic manipulation*. CRC press, 2017.

[2] Lynch, Kevin M., and Frank C. Park. *Modern robotics*. Cambridge University Press, 2017.

TEE 227123

Modern SCADA Technology

Teknologi SCADA Modern

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Basic Power Systems (recommendation) Basic Telecommunications (recommendation)

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
-
-

Learning Outcomes (Max. 6)

LO1 Students can explain the structure of the power system SCADA and define each of SCADA components' functions (Bloom level IV).

LO2 Students can relate the merit of SCADA to realizing smart grids (Bloom level IV).

COURSE DESCRIPTION

In this course, students will learn the structure and functions of a SCADA network in a power system. In the end, having enough understanding int the function of the SCADA, students will realize the contributions of the network to the future of the smart grid.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers:

1. Power system automations,
2. SCADA Fundamentals,
3. SCADA Communications,
4. Substation Automations,
5. Energy management systems,
6. Distribution automations and managements,
7. Smart Grid Concepts,

REFERENCES

[1] Mini S. Thomas, John Douglas McDonald, “Power System SCADA and Smart Grids”, CRC Press, 2020.

[2] Clarke, G., Reynders, D. and Wright, E., 2004. *Practical modern SCADA protocols: DNP3, 60870.5 and related systems*. Newnes.

TEE227244

Intelligent Control System

Sistem Kendali Cerdas

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris Modelling, Advanced Math

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
- Engineering Design
-

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) intelligent system and solve the problems using intelligent system and understand about knowledge based system.

LO2 Students are able to explain (Bloom taxonomy level IV) the basic principle of fuzzy system, fuzzy logic system, advanced fuzzy logic (type-2), extended fuzzy system (neurofuzzy, ANFIS, fuzzy-GA), design and evaluation of some intelligent systems.

LO3 Students are able to explain and analyze (Bloom taxonomy level IV) the stability and performance of control system

LO4 Students are able to design (Bloom taxonomy level VI) and evaluate (Bloom taxonomy level V) the intelligent control systems to improve the performance and stability.

LO5

LO6

COURSE DESCRIPTION

Students learn about intelligent system and some algorithms especially fuzzy logic and its extensions, performance and stability of control system, and design and evaluation of intelligent control system using fuzzy logic, neurofuzzy, fuzzy-GA, type-2 fuzzy logic, etc.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers some topics as follow:

1. Introduction to Intelligent System

2. Several Algorithms of Intelligent System

3. Performance and Stability of Control System

4. Design and Evaluation of Intelligent Control System

The topics are broken down into some sub-topics below :

1.1 Introduction to Intelligent System and Problem Solving Process

1.2 Knowledge Representation and Rule-based System

2.1 Introduction to Fuzzy Logic

2.2 Fuzzy Mathematics

2.3 Fuzzy Process and Evaluation

2.4 Neural Network and ANFIS

2.5 Type-2 Fuzzy Logic, Genetic Algorithms, and ACO

3.1 Control System and Performance

3.2 PID Control

3.3 Control System Stability

4.1 Control System Design

4.2 Design of Intelligent Control System

4.3 Analysis and Evaluation of Intelligent Control Systems

REFERENCES

[1] Om Parkash. http://www.ddegjust.ac.in/studymaterial/mca-5/mca-402.pdf. Paper code: MCA 42

[2] L. Wang, A Course in Fuzzy System and Control, Upper Saddle River, New Jersey 07458: Prentice-Hall, Inc, A Division of Simon and Schuster, 1997.

[3] K. Man, S. Tang, and W. Halang, Genetic Algorithms for Control and Signal Processing, Britain: Springer-Verlag London Limited, 1997.

[4] N.S. Nise, Control System Engineering, Hoboken, NJ: John Wiley & Sons Ltd., 2004.

[5] J. Jacob, Industrial Control Electronics, Englewood Cliffs, NJ.: Prentice-Hall International Editions, 1989.

[6] M. Jamshidi and M. Zavarei, Linear Control Systems : A Computer-Aided Approach., Great Britain: Wheaton & Co.Ltd., 1986.

[7] Hung T. Nguyen, Nadipuram R. Prasad, Carol L. Walker , Elbert A. WalkerA First Course In Fuzzy and Neural Control, Chapman & Hall/CRC, 2003.

[8] Passino, KM and Yurkovich, S. Fuzzy Control. Addison Wesley Longman, Inc. Californio 94025. 1998.

[9] Castillo, O. Type-2 Fuzzy Logic in Intelligent Control Applications. Studies in Fuzziness and Soft Computing, Vol. 272. Springer-Verlag Berlin Heidelberg. 2012.

[10] Web

TEE227212

Advanced Image Processing

Pengolahan Citra Lanjut

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris Enter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

Learning Outcomes (Max. 6)

LO Students can explain (Bloom taxonomy level IV) fundamental concepts and techniques of image processing (mathematics for image processing, image perception, colour image processing, enhancement, filtering, restoration, compression, segmentation, morphological operation, feature extraction and analysis).

LO2 Students can analyze (Bloom taxonomy level IV) theoretical framework to understand new developments in image processing.

LO3 Students can establish (Bloom taxonomy level IV) problem solving skills in image processing with an emphasis on practical usage, rather than mere discussion of algorithms.

LO4 Students can demonstrate (Bloom taxonomy level IV) solid understanding of the theory through coding and implementation of image processing algorithms in Matlab, Python or Tensorflow.

COURSE DESCRIPTION

This advanced image processing course covers fundamental concepts and techniques in image processing and their applications. This course material covers the understanding and scope of image processing techniques consisting of image perception, colour image processing, enhancement, filtering, restoration, compression, segmentation, morphological operation, feature extraction and analysis for image classification and recognition. This course also introduces to the exciting and rapidly advancing fields of image processing including deep learning technologies.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers specific topics as follows:

1. Introduction
2. Fundamental of image processing techniques
3. Image perception
4. Colour image processing
5. Image enhancement and filtering
6. Image compression
7. Image segmentation

8. Morphological image processing
9. Feature extraction and analysis
10. Object recognition
11. Fundamentals and applications of deep learning in image processing

REFERENCES

[1] Rafael C.Gonzalez & Richard E.Woods – Digital Image Processing – Pearson Education- 3rd/e – 2008.

[2] William K. Pratt: Digital Image Processing, 4th Edition, John Wiley & Sons Inc., 2007.

TEE 227214

Biomedical Signal Analysis

Analisis Isyarat Biomedis

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) types and characteristics of biomedical signals

LO2 Students are able to explain (Bloom taxonomy level IV) biomedical signal processing

LO3 Students are able to explain (Bloom taxonomy level IV) biomedical image processing

LO4 Students are able to explain (Bloom taxonomy level IV) existing methods and how these methods are applied to solve related biomedical problems

LO5 Students are able to present their biomedical signal analysis project results in oral and written forms (Bloom taxonomy level IV)

COURSE DESCRIPTION

The students will learn basic concept and characteristics of biomedical signals with emphasize on problems related to biomedical research. The discussion including principles

and algorithms for biomedical signal acquisition, filtering, processing, feature recognition, time and frequency domain representation, intelligent system based analysis and biomedical image analysis.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers as follows.

Biomedical signal analysis definition and scope.

Types and characteristics of biomedical signals.

Biomedical signal processing.

Biomedical imaging.

Biomedical image processing.

Biomedical image processing applications.

Physiological origin of biomedical signals (ECG, EEG, PCG, EOG, others).

Biomedical signal acquistion, discrete time signals, z-transform, and filter design.

Biomedical signal analysis (ECG and EEG).

REFERENCES

[1] RANGAYYAN, R. M. (2005). Biomedical image analysis. Boca Raton, Fla, CRC Press.

[2] THEIS, F. J., & MEYER-BÄSE, A. (2010). Biomedical signal analysis: contemporary methods and applications. Cambridge, Mass, MIT Press.

TEE 227215

Deep Learning System

Sistem Pembelajaran Dalam

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) Deep Learning

LO2 Students are able to evalute (Bloom taxonomy level V) applications of Deep Learning

COURSE DESCRIPTION

The students learn about the basics of deep neural networks, and their applications to various AI tasks. By the end of the course, it is expected that students will have significant familiarity with the subject, and be able to apply Deep Learning to a variety of tasks. They will also be positioned to understand much of the current literature on the topic and extend their knowledge through further study.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Topic 1: The Simplest Possible Neural Network

- What Is Machine Learning?
- What Is a Neural Network?
- Building the Simplest Neural Network in Simple Python
- Multiple Input
- Multiple Outputs
- Use NumPy to Build Neural Networks
-

2. Topic 2: Updating Weights in Simplest Neural Network

- Simple Error Analysis
- Working with 1 Attributes
- Small Steps
- Extending Simplest Neural Network to Multiple Inputs
- Extending to Multiple Outputs
- Combining Multiple Input and Outputs

3. Topic 3: Extending to Complete Data Sets

- Error vs. Cost
- Extending Neural Network to Use Multiple Samples
- Goodness of Fit Parameters

4. Topic 4: Understanding Back Propagation

- Review of NumPy Arrays
- Introduction to Stacked Arrays
- Extending
- Backpropagation
- Coding Examples

5. Topic 5: Multiple Layers and Back Propagation

- Introduction to Deep Learning
- Forward Propagation
- Back Propagation
- Working Example

6. Topic 6: Parameters Affecting Deep Learning

- Normalization
- Data Size
- Regularization
- Weight Initialization
- Working Though Coding Changes

7. Topic 7: Introduction of DL Framework

- Why Framework?
- Working Examples

8. Topic 8: Using DL for Vision – Convolution Neural Networks

- The Problems of Pictures
- A Solution
- Implementing Solution
- What You Really Need to Know

REFERENCES

[1] Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

[2] Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive Into Deep Learning, 2020

TEE 227213

Pattern Classification and Recognition

Teknik Klasifikasi dan Pengenalan Pola

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Komputasi numeris Enter Prerequisite

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) the concepts of classification and recognition.

LO2 Students are able to explain (Bloom taxonomy level IV) about Linear Classifier.

LO3 Students are able to explain (Bloom taxonomy level IV) Non-Linear Classifier.

LO4 Students are able to explain (Bloom taxonomy level IV) Features Extraction and Selection.

COURSE DESCRIPTION

This course covers the fundamentals of characterizing and recognizing patterns and features. We discuss the basic tools and theory for signal understanding problems with applications to user modeling, affect recognition, speech recognition and understanding, computer vision, physiological analysis, and more. We also cover decision theory, statistical

classification, maximum likelihood and Bayesian estimation, nonparametric methods, unsupervised learning and clustering.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. Bayes Decision Theory
2. Linear Classifiers
    a. Support Vector Machines
    b. K-Nearest-Neighbor Classification
    c. Perceptron Algorithm
    d. Least-Squares Methods
3. Nonlinear Classifiers
    a. Multilayer Perceptron's
    b. Back Propagation Algorithm
4. Feature Selection
5. Dimensionality Reduction
    a. Basis Vectors
    b. Singular Value Decomposition
    c. Independent Component Analysis
    d. Kernel PCA
6. Additional Features And Template Matching
    a. Texture, Shape and Size Characterization
    b. Fractals

c. Features For Audio
7. Context Dependent Classification
8. Clustering

REFERENCES

[1] Theodoridis, S. and K. Koutroumbas, Pattern recognition. 4th ed. 2009, San Diego, CA: Academic Press

[2] Pattern Classification (2nd. Edition) by R. O. Duda, P. E. Hart and D. Stork, Wiley 2002,

TEE 227211

Advanced Digital Signal Processing

Teknik Pengolahan Isyarat Digital Lanjut

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Signal and System (Bachelor), Digital Signal Processing (Bachelor)

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Development of Engineering Solution
- Fundamental of Engineering Knowledge
-
-

Learning Outcomes (Max. 6)

LO1 The students can evaluate (Bloom taxonomy level V) the relationship between analog signal and its digital samples representation in both time and frequency domain (review on discrete-time Fourier transform will be very important)

LO2 The students are able to evaluate (Bloom taxonomy level V) discrete-time signal and system both in time and frequency domain using Z-Transforms and discrete Fourier transform

LO3 The students are able to evaluate (Bloom taxonomy level V) digital filter design criteria and design FIR and IIR filters

LO4 The students are able to examine (Bloom taxonomy level V) multirate signal processing, which include filter bank theory, subband coding and wavelet

LO5 The students are able to examine (Bloom taxonomy level V) advanced digital signal processing techniques including linear predictive coding, Wiener filter, and Vector Quantization

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

The students learn about the relationships beween analog signal and its representation in digital samples both in time and frequency domain, which require a very strong backround understanding in both continuous-time and discrete-time Fourier transform. The course then introduces how to further evalaute discrete-time signal and system using Z-transform. The transition from discrete-time Fourier transform (DTFT) into discrete Fourier transform (DFT) is also introduced followed by DFT implementation in the form of fast Fourier transform algorithm. The latter part of the course introduces the digital filter design. This is followed by an interesting topic of multi-rate signal processing, which includes discussion on filter bank, subband coding, and wavelet transform. The course then touch upon advance topics such as linear predictive coding, Wiener filter and vector quantization.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers ….

1. Review on continuous-time signal and system
2. Review on discrete-time Fourier transform (DTFT)
3. Discrete-time signal and linear time-invariant system
4. Digital LTI system analysis using Z-transform
5. Frequency-domain analysis on digital LTI system using DTFT)
6. Discrete Fourier transform (DFT) and its use for frequency domain analysis
7. Fast Fourier transform algorithm as DFT implementation
8. Introduction to digital filter
9. Digital filter design (FIR and IIR filters design)
10. Multirate signal processing including downsampling and upsampling operations and its analysis in time-frequency domain, filter bank theory, subband coding and wavelet transform
11. Linear predictive coding
12. Wiener filter
13. Vector quantization

REFERENCES

[1] Proakis, J.G. and Manolakis D. Digital Signal Processing, 4th edition, Pearson, 2007.

[2] Oppenheim, A.V. and Schaffer, R.W. Discrete-Time Signal Processing, 3rd edition, Pearson, 2009.

TEE 227224

RF Microelectronics

Mikro Elektronika RF

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Undergraduate Level Electronic Courses

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to analyze (Bloom taxonomy level IV) the behaviour of RF microelectronics circuits

LO2 Students are able to design (Bloom taxonomy level VI) RF microelectronics circuits to meet the desired specifications

LO3 Enter Learning Outcome (Delete this row if this LO is empty)

LO4 Enter Learning Outcome (Delete this row if this LO is empty)

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

COURSE DESCRIPTION

RF Microelectronics course introduces the fundamentals of circuit design using MOS transistor, especially for Radio Frequency (RF) or high-frequency applications. Students are expected to have taken the undergraduate level electronic courses so that the topics discussed in this course can be easier to understand. This course covers several topics as follows: basic MOS transistor, basic microelectronics circuits, and application especially related to oscillators and PLL circuits.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

1. Introduction

1.1 Introduction to Analog Design

1.2 Basic MOSFET Transistor Structure

1.3 MOS I/V Characteristics

1.4 Second-Order Effects

1.5 MOS Device Model

2. Single-Stage Amplifiers

2.1 General Considerations

2.2 Common-Source Stage

2.3 Source-Follower

2.4 Common-Gate Stage

2.5 Cascode Stage

3. Differential Amplifiers

3.1 Single-Ended and Differential Operations

3.2 Basic Differential Pair

3.3 Common-Mode Response

3.4 Differential Pair with MOS Loads

3.5 Gilbert Cell

4. Current Mirrors

4.1 Basic Current Mirrors

4.2 Cascode Current Mirrors

4.3 Active Current Mirrors

5. Frequency Response of Amplifiers

5.1 Frequency Response of Common-Source Stage

5.2 Frequency Response of Source-Followers

5.3 Frequency Response of Common-Gate Stage

5.4 Frequency Response of Cascode Stage

5.5 Frequency Response of Differential Pair

6. Noise

6.1 Statistical Characteristics of Noise

6.2 Types of Noise

6.3 Representation of Noise in Circuits

6.4 Noise in Single-Stage Amplifiers

6.5 Noise in Differential Amplifiers

6.6 Noise Bandwidth

7. Feedback

7.1 Feedback Topologies

7.2 Effect of Loading

7.3 Effect of Feedback on Noise

8. Operational Amplifiers

8.1 Performance Parameters

8.2 Single-Stage Operational Amplifiers

8.3 Two-Stage Operational Amplifiers

8.4 Gain Boosting

8.5 Common-Mode Feedback

8.6 Slew Rate

8.7 Power Supply Rejection

8.8 Noise in Operational Amplifiers

9. Stability and Frequency Compensation

9.1 Multipole Systems

9.2 Phase Margin

9.3 Basic Frequency Compensation

9.4 Compensation of Two-Stage Operational Amplifiers

9.5 Other Compensation Techniques

10. Bandgap References

10.1 Supply Independent Biasing

10.2 Temperature Independent References

10.3 PTAT Current Generation

10.4 Constant-*Gm* Biasing

10.5 Speed and Noise Issues

10.6 Case Study

11. Switched-Capacitor Circuits

11.1 Sampling-switched

11.2 Switched-Capacitor Amplifier

11.3 Switched-Capacitor Integrator

11.4 Switched-Capacitor Common Mode Feedback.

12. Nonlinearity and Mismatch

12.1 Nonlinearity

12.2 Mismatch

13. Oscillators

13.1 Ring Oscillators

13.2 LC Oscillators

13.3 Voltage-Controlled Oscillators (VCO)

REFERENCES

[1] Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill International Edition, 2001.

[2] Johns and Martin. "Analog Integrated Circuit Design", 1997.

[3] Gray and Meyer. "Analysis and Design of Analog Integrated Circuits, 4th edition.

[4] Allen and Holberg. "CMOS Analog Circuits Design", 2002

[5] Papers from IEEE Journal of Solid-State Circuits.

TEE 227245

Nonlinear Control Systems

Sistem Kendali Nonlinear

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Undergraduate Level Control Systems Courses

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to analyze (Bloom taxonomy level IV) nonlinear system, and model it in a nonlinear differential equations lumped parameter.

LO2 Students are able to explain (Bloom taxonomy level IV) the linearization concept to change the nonlinear equation model into linear state space model, transfer function and vice versa.

LO3 Students are able to analyze (Bloom taxonomy level IV) the behaviour of nonlinear systems.

LO4 Students are able to evaluate (Bloom taxonomy level V) the control mechanism of nonlinear systems.

LO5 Enter Learning Outcome (Delete this row if this LO is empty)

LO6 Enter Learning Outcome (Delete this row if this LO is empty)

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

COURSE DESCRIPTION

1. Introduction

1.1 Nonlinear Models and Nonlinear Phenomena

1.2 Examples of Nonlinear Systems

2. Second-Order Systems

2.1 Multiple Equilibria

2.2 Qualitative Behaviour Near Equilibrium Points

2.3 Limit Cycles

2.4 Phase Portrait

2.5 Bifurcation

3. Fundamental Properties

3.1 Existence and Uniqueness

3.2 Continuous Dependence on Initial Conditions and Parameters

3.3 Differentiability of Solutions and Sensitivity Equations

3.4 Comparison Principle

4. Lyapunov Stability

4.1 Autonomous Systems

4.2 The Invariance Principle

4.3 Linear Systems and Linearization

5. Feedback Control and Linearization

5.1 Control Problems

5.2 Stabilization via Linearization

5.3 Input-Output Linearization

5.4 Full-State Linearization

5.5 State-Feedback Control

TOPICS

Nonlinear Control Systems course introduces the fundamentals of control systems theory related to nonlinear systems. Students are expected to have taken the undergraduate level control systems engineering courses (control systems theory related to linear systems) so that the topics discussed in this course can be easier to understand. This course covers several topics as follows: nonlinear systems and their mathematical model, basic characteristics of nonlinear systems, stability of nonlinear systems, as well as several techniques related to nonlinear control systems.

REFERENCES

[1] Hassan K. Khalil, 2002., Nonlinear Systems, 3rd Edition

[2] Sastry, S., 2013. *Nonlinear systems: analysis, stability, and control* (Vol. 10). Springer Science & Business Media.

TEE227235

Information Theory and Coding

Teori Informasi dan Penyandian

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Advanced statistics

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) the concepts of information theory, and entropy.

LO2 Students are able to explain (Bloom taxonomy level IV) about some source coding, and compression.

LO3 Students are able to explain (Bloom taxonomy level IV) channel coding.

LO4 Students are able to explain (Bloom taxonomy level IV) error correction in data communication.

COURSE DESCRIPTION

This course is about information theory and coding in data communications. The course covers Information representation: decorrelation coding and entropic coding, Information security: cryptographic coding, and Information correction: channel coding theory and error-correcting codes.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers the following topics:

1. Mathematical Background and Basic Concepts in Probability Theory.
2. Basic notions in information theory; mutual information and entropy.
3. Discrete source coding by fixed length-codes and variable-length codes.
4. Decorrelation coding and coding gain notions.
5. Basic notions in cryptology; secret-key and public-key cryptographic coding systems.
6. Discrete memoryless channel; capacity notion; noisy channel coding theorem.
7. General block coding theory; role of the minimum distance.
8. Linear codes: generator matrix and parity-check matrix; syndrome decoding.
9. Study of certain classes of linear block codes: cyclic codes and Reed-Solomon codes.
10. Convolutional codes..

REFERENCES

[3] Cover, Thomas M. 2006, Elements of Information Theory, 2nd, Wiley-Interscience

[4] Lin, Shu; Costello, D. J. 2004, Error Control Coding, 2nd, Prentice-Hall, New Jersey

[5] David MacKay, Information Theory, Inference, and Learning Algorithms, Cambridge University Press, 2003.

TEE 227119

Transient in Electric Power Systems

Transien dalam Sistem Tenaga Listrik

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Power System Analysis, Basic Power System, Numerical Computation

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) the transient concept in electric power systems

LO2 Students are able to build (Bloom taxonomy level V) the model for transient condition in electric power systems

LO3 Students are able to analyze (Bloom taxonomy level IV) transient condition in electric power systems

COURSE DESCRIPTION

The students learn about transient phenomena in electric power systems.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers:

1. Basic concepts of switching transients
2. Transient analysis of three-phase power systems
3. Travelling waves and other transients in transmission lines
4. Switching transients
5. Lightning
6. Power system transient recovery voltage (TRV)
7. Numerical simulation of electrical transients
8. Insulation coordination
9. Circuit breakers

REFERENCES

[1] van der Sluis, 2001, *Transients in Power Systems*, Wiley, UK
[2] Greenwood, 1990, *Electrical Transients in Power Systems*, Wiley, US

TEE 227124

High Voltage Direct Current Transmission

Transmisi Arus Searah

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Power Electronics, Power System Analysis, Basic Power System

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to distinguish (Bloom taxonomy level IV) LCC and VSC HVDC technology

LO2 Students are able to build (Bloom taxonomy level V) a model for designing HVDC transmission system

COURSE DESCRIPTION

The students learn about high voltage direct current (HVDC) technologies used for bulk power system transmission.

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods		
Type	**Percentage**	**LO**
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers introduction to HVDC technologies: line commutated converter (LCC) and voltage source converter (VSC), different configuration (point-to-point and multi terminal), modeling of these technologies, and design aspect for HVDC transmission system.

REFERENCES

[3] Jovcic and Ahmed, 2015, *High-Voltage Direct-Current Transmission: Converters, Systems and DC Grids*, Wiley, UK

[4] Irnawan, 2020, *Planning and Control of Expandable Multi-Terminal VSC-HVDC Transmission Systems*, Springer, Germany

[5] Jardini, et.al., 2013, *Modelling and Simulation Studies to be performed during the lifecycle of HVDC Systems*, Cigré, France

TEE227216

Computer Vision

Visi Komputer

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Elective
Prerequisites	Advanced mathematics, Advanced statistics, Basic programming

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
-
-

Learning Outcomes (Max. 6)

LO1 Students are able to explain (Bloom taxonomy level IV) basic concepts of computer vision and its application.

LO2 Students are able to explain (Bloom taxonomy level IV) basic mathematical concept in image processing algorithm.

LO3 Students are able to explain (Bloom taxonomy level IV) basic concept of image enhancement

LO4 Students are able to explain (Bloom taxonomy level IV) and evaluate (Bloom taxonomy level V) concept of image filtering

LO5 Students are able to explain (Bloom taxonomy level IV) concept of segmentation, morphology, and feature extraction

LO6 Students are able to explain (Bloom taxonomy level IV) and evaluate (Bloom taxonomy level V) concept of machine learning and/or deep learning.

COURSE DESCRIPTION

The students learn about fundamental concepts of computer vision in theoretical framework as well as practical implementation. This course includes definition and scopes of computer vision, mathematical tools in computer vision, image enhancement, image filtering, and some advanced computer vision techniques such as segmentation, morphological image processing, feature extraction, machine learning, deep learning. Besides attending classroom lecture, the students will learn to implement some computer vision techniques through a particular programming language (e.g.,: Python or MATLAB).

Delivery methods

[1] Lectures

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Midterm exam	XX %	LOx
[2] Final Exam	XX %	LOx
[3] Quizzes	XX %	LOx
[4] Assignments	XX %	LOx

TOPICS

This course covers:

1. Introduction to Computer Vision

2. Mathematical Tools for Image Processing 1: Matrix, Linear System, Eigenvalues and Eigenvectors
3. Mathematical Tools for Image Processing 2: Eigen Decomposition, Singular Value Decomposition
4. Camera model and image enhancement
5. Pixel-based image enhancement and spatial filtering
6. Filtering in frequency domain
7. Implementation of image filtering using Python
8. Segmentation and Morphology
9. Feature Extraction: Corner Detection
10. Introduction to Machine Learning
11. Introduction to Deep Learning
12. Convolutional Neural Networks

REFERENCES

[1] R.C. Gonzalez, R.E. Woods, "Digital Image Processing: 4th Edition," New York: Pearson, 2018.

[2] A. Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: 2nd Edition," California: O'Reilly, 2019

[3] J. Krohn, G. Beyleveld, A. Bassens, "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence," New York: Pearson Education, 2020.

[4] G. Strang, "Introduction to Linear Algebra: 5th Edition," Wellesley MA: Wellesley-Cambridge Press, 2016.

TEE226203

Seminar I

Seminar I

BASIC INFORMATION

Course Credit	1
Course Type	Compulsary
Prerequisites	-

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
- Effective Communication
-

Learning Outcomes (Max. 6)

LO1 Students are able to perform criticial review based on the student's research (Bloom taxonomy level V).

LO2 Students are able to write (Bloom taxonomy level VI) technical report systematically for the student's research.

LO3 Students are able to present the research progress (Bloom taxonomy level VI).

LO4

LO5

LO6

COURSE DESCRIPTION

This subject directs students to perform criticial review based on the student's research, write technical report systematically for the student's research, and present the research progress. In this subject, students are required to present the research progress systematically.

Delivery methods

[1] Presentation

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Oral exam	**100** %	LO1-LO3

TOPICS

This subject covers:

1. Critical Review
2. Systematic Analytical Report
3. Research Presentation

REFERENCES

[1] T. Hengl and M. Gould, "Rules of Thumb for Writing Research Articles", 2002. Available online: https://webapps.itc.utwente.nl/librarywww/papers/hengl_rules.pdf

[2] H. Glasman-Deal, "Science Research Writing: For Non-Native Speakers of English", London: Imperial College Press, 2018

[3] S. Howe, "Phrasebook for Writing Papers and Research in English", Cambridge: The Whole World Company, 2007.

[4] Relevant papers on the research topic.

TEE227201

Seminar 2

Seminar 2

BASIC INFORMATION

Course Credit	1
Course Type	Compulsary
Prerequisites	Seminar I, Scientific Writing

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

- Engineering Solution
- Data, Experiments, and Modelling
- Effective Communication
-

Learning Outcomes (Max. 6)

LO1 Students are able to analyze (Bloom taxonomy level IV) the student's research outcomes.

LO2 Students are able to write preliminary thesis systematically based on the student's research (Bloom taxonomy level VI).

LO3 Students are able to present and explain thoroghly the research outcomes (Bloom taxonomy level VI).

LO4

LO5

LO6

COURSE DESCRIPTION

This subject directs students to analyze the student's research outcomes, write preliminary thesis systematically based on the student's research, and present and explain thoroughly the research outcomes. In this subject, students are required to present the research outcomes systematically and prepare a preliminary draft for the thesis.

Delivery methods

[1] Presentation

[2] Discussion

[3] etc

Assessment methods

Type	Percentage	LO
[1] Oral exam	100 %	LO1-LO3

TOPICS

1. Analysis of the student's research outcomes.
2. Writing preliminary thesis systematically based on the student's research.
3. Presentating and explaining thoroughly the research outcomes.

REFERENCES

[1] T. Hengl and M. Gould, "Rules of Thumb for Writing Research Articles", 2002. Available online: https://webapps.itc.utwente.nl/librarywww/papers/hengl_rules.pdf

[2] H. Glasman-Deal, "Science Research Writing: For Non-Native Speakers of English", London: Imperial College Press, 2018

[3] S. Howe, "Phrasebook for Writing Papers and Research in English", Cambridge: The Whole World Company, 2007.

[4] Relevant papers on the research topic.

REFERENSI

1. Undang-undang No. 012 Tahun 2012 tentang Pendidikan Tinggi.
2. Peraturan Presiden No. 008 Tahun 2012 tentang Kerangka Kualifikasi Nasional Indonesia.
3. Peraturan Menteri Dalam Negeri No. 002 Tahun 2013 tentang Pedoman Pengembangan Sistem Pendidikan dan Pelatihan Berbasis Kompetensi.
4. Peraturan Menteri Pendidikan dan Kebudayaan No. 073 Tahun 2013 tentang Penerapan Kualifikasi Kompetensi Nasional Indonesia bidang Pendidikan Tinggi.
5. Peraturan Menteri Pendidikan dan Kebudayaan No. 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi.
6. PP RI No. 67 Tahun 2013 tentang Statuta UGM.
7. Peraturan Rektor UGM No. 11 Tahun 2016 tentang Pendidikan Pascasarjana.
8. Peraturan Rektor UGM No. 18 Tahun 2019 tentang Penyelenggaraan Program Pascasarjana Berbasis Penelitian (*by Research*) di Lingkungan Universitas Gadjah Mada.
9. Peraturan Rektor UGM No. 14 Tahun 2020 tentang Kerangka Dasar Kurikulum.
10. Kurikulum Magister Teknik Elektro 2017.