TKU211201

Complex Variable Analysis

Analisa Variable Kompleks

BASIC INFORMATION

Course Credit	3 / 150 minutes per Week
Course Type	Required
Course Classification	Basic Science
Prerequisites	Multi-Variable Calculus

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

Fundamental and Engineering Knowledge (KP.1)

Development of Engineering Solution (KP.2)

Engineering Design (KP.3)

Learning Outcomes

LO1 Students are able to understand the complex number and basic operations, and analytic funtions.

LO2 Students are able to perform integration on complex functions using Cauchy's Theorem and Cauchy's integral formula.

LO3 Students are able to identify the exsitance of Taylor and Laurent series of an analytic functions.

LO4 Students are able to understand Fourier series and Fourier transform.

COURSE DESCRIPTION

Complex analysis is a fundamental in developing solution to many practical problems. It discusses the calculus of complex functions with the main results around Cauchy's Theorem, Cauchy's integral formula, and the existence of Taylor and Laurent series. In the last part of the course, students will also learn the application of complex analysis, namely Fourier series and Fourier transform.

TOPICS

1. Introduction to Complex Numbers and Basic Operations

1.1 Summation
1.2 Subtraction
1.3 Conjugation
1.4 Triangle of Inequality
1.5 Roots of Complex Number
1.6 Area within Complex Plane

2. Analytical Functions

2.1 Function and Mapping

2.2 Limit Theorem
2.3 Continuity
2.4 Differentiation and Complex Variables
2.5 Some Conditions in Complex Differentiation
2.6 Cauchy Riemann Equation
2.7 Polar Coordinate
2.8 Analytical Functions
2.9 Harmonics Functions

3. Elementary Function
3.1 Exponential Functions
3.2 Logarithmic Functions
3.3 Trigonometric Functions
3.4 Hyperbolic Functions

4. Complex Integration
4.1 Definite Integral
4.2 Contour and Contour Integral
4.3 Branch Cuts
4.4 Anti Derivatives
4.5 Cauchy-Goursat Theorem
4.6 Connected-Domains
4.7 Cauchy Integral Formula

5. Series
5.1 Series and its Convergences
5.2 Taylor Series
5.3 Laurent Series
5.4 Convergence of Geometric Series
5.5 Continuity of Geometric Series
5.6 Integration and Differentiation of Geometric Series
5.7 Operations on Geometric Series

6. Residue
6.1 Residue
6.2 Cauchy Residue Theorem
6.3 Residues at Poles
6.4 Zeros of Analytic Functions
6.5 Zeros and Poles

7. Introduction to Signal
7.1 Discrete and Continuous Signal
7.2 Impulse and Step Signals
7.3 Free Variables its Transformations

7.4 Periodic Signals
7.5 Even and Odd Signals
7.6 Power and Energy Signals

8. Fourier Series for Continuous Signals

8.1 Fourier Series for Periodic Signals

8.2 Decomposition of Periodic Signal into Linear Combination of Sinusoidal Function

8.3 Decomposition of Periodic Signal into Linear Combination of Complex Exponential Function

8.4 Dirichlet Condition

8.5 Properties of Fourier Series

9. Fourier Transform for Continuous Time Signal

9.1 Fourier Transform for Aperiodic Signal

9.2 Fourier Transform for Periodic Signal

9.3 Condition for Fourier Transform

9.4 Properties of Fourier Transform (excluding multiplication and convolution)

REFERENCES

[1] Brown, James Ward and Ruel V. Churchill. Complex Variables and Applications. 9th ed. McGraw-Hill Education, 2013. ISBN: 9780073383170.

[2] Oppenheim, A.V., Willsky, I., 1998, Signals and Systems, 2nd ed., Prentice Hall