

## Course Outline

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Department of Mathematics & Statistics  
Faculty of Science

**MATH 3000 – 3 Credits**  
**Complex Variables (3,1,0)**  
**Fall, 2015**

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### Calendar Description

This course introduces classical complex function theory, a cornerstone of mathematics. Topics include complex derivatives and the Cauchy-Riemann equations, the complex exponential function and related elementary functions, integration along curves and Cauchy's theorems, Taylor and Laurent series, zeros and singularities, residues, and evaluation of integrals using the residue theorem.

### Education Objectives/Outcomes

On completion of the course students will be expected to:

- Solve problems involving complex numbers using both algebraic and geometric techniques;
- Calculate limits, derivatives and integrals of complex functions;
- Evaluate contour integrals of complex functions using both parametrizations and residues;
- Calculate and manipulate power series and Laurent series for complex functions;
- State the basic theorems of complex function theory (including Cauchy's theorem, Liouville's theorem and the residue theorem) and apply them to solve problems.

### Prerequisites

MATH 2200 (Intro to Analysis) or MATH 3170 (Calculus 4) – both are recommended.

### Texts/Materials

*Required:*

E. B. Saff and A. D. Snider, *Fundamentals of Complex Analysis with Applications to Engineering and Science*, 3rd Edition, Prentice Hall, 2003.

### Student Evaluation

Weekly quizzes ( $\times 8$ ) .....	15%
Midterm exams ( $\times 2$ ) .....	40%
Final exam .....	45%

Missed quizzes and exams will result in a mark of zero unless the student provides a valid reason and receives prior approval from the instructor.

NOTE: The final examination will be written at a time between Dec. 10 and Dec. 22, as scheduled by the Registrar's Office. The examination could be scheduled at any time during this period. Students should plan accordingly.

For detailed information on policies and regulations regarding examinations please refer to the TRU calendar.

## Course Topics

### 1. Complex Numbers

Algebra of complex numbers .....	1.1
Geometric representation: The complex plane .....	1.2, 1.3
Polar representation .....	1.3
Complex exponential .....	1.4
Powers and roots .....	1.5

### 2. Analytic Functions

Complex functions .....	2.1
Limits and continuity .....	2.2
Analyticity .....	2.3
Cauchy-Riemann equations .....	2.4
Harmonic functions .....	2.5

### 3. Elementary Functions

Polynomial and rational functions .....	3.1
Exponential, trigonometric and hyperbolic functions .....	3.2
Logarithmic functions, branches .....	3.3
Complex powers .....	3.5
Inverse trigonometric functions .....	3.5

### 4. Complex Integration

Curves and parametrizations .....	4.1
Integration along curves .....	4.2
Path independence .....	4.3
Cauchy's integral theorem .....	4.4
Cauchy's integral formula, Morera's theorem .....	4.5
Cauchy estimates, fundamental theorem of algebra .....	4.6

### 5. Series Representations

Sequences and series .....	5.1
Power series .....	5.2, 5.3
Laurent series .....	5.5
Zeros and singularities .....	5.6

### 6. Residue Theory

Residue theorem .....	6.1
Evaluating of integrals by residues, Jordan's lemma .....	6.2–6.4