Functions of a Complex Variable

Math 4417, FALL 2017

Instructor: Dr. Nicolae R. Pascu
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MEETING TIMES/LOCATION: TuTh 9:30 am - 10:45 am / D113

Goals:
1. Use properties of elementary functions (trigonometric, exponential, etc.) of a complex variable.
2. Determine if a given function of a complex variable is continuous/ analytic/ integrable.
4. Perform elementary calculations with Taylor and Laurent series.
5. Apply the techniques of complex analysis to solve certain applied problems (e.g. compute certain Riemann integrals, determine certain conformal maps or harmonic functions with given boundary values).

OFFICE HOURS: MW 11:00 - 12:00, or by appointment.

PREREQUISITE: MATH 2203 (Calculus III) - Minimum Grade of C.

COURSE DESCRIPTION: This course is an introduction to the basic concepts of complex analysis, its beautiful theory and powerful applications. Topics covered will include: the algebra and geometry of the complex plane, properties of elementary functions of a complex variable, analytic and harmonic functions, conformal mappings, continuity, differentiation, integration (Cauchy integral theory), singularities, Taylor and Laurent series, residues and, time permitting, their applications.

CLASS ATTENDANCE: I strongly suggest the attendance to class. If you miss a class, it is your responsibility to find make up the material and make sure your homework is turned in on time.

HOMEWORK: For each section, there will be a minimum number of problems, which I strongly suggest to be done by the next class meeting. There will be about ten homework assignments; the lowest grade will be dropped. Late homework will not be accepted under any circumstances.

COURSE POLICY: There will be three in-class tests tentatively scheduled for September 7th, October 5th, and November 2nd respectively. The final exam is cumulative (the date/time will be announced later in class).

There will be NO MAKE-UP quizzes, exams. Should there be a special circumstance giving you a valid reason for a makeup exam (such as a medical emergency), let me know in advance of this situation by sending me an email (npascu@spsu.edu) BEFORE the exam takes place.

Evaluation: There will be 3 regular exams, each worth 20% of your grade. A comprehensive final exam will be worth 20%. Homework will be 20%. The scale for converting your score to letter grades is the usual one (90% or more is an A, 80-89% is a B, 70-79% is a C, 60 - 69% is a D, below 60% is a F).
**EXPECTATIONS:** I expect you to read the textbook (solved examples, especially). The only way to get through this course is to work constantly. This includes doing your homework exercises and going over the notes, and textbook. The only way to know math is to practice. This is the only "secret".

**IMPORTANT DATES:** Labor Day Holiday September 2\(^{nd}\) - 4\(^{th}\) / The last day to withdraw from class with a grade of "W" is October 4\(^{th}\)/ Thanksgiving Holiday November 20\(^{th}\) - 26\(^{th}\)/ Last day of classes December 4\(^{th}\).

**STUDENTS WITH DISABILITIES:** Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the counselor working with disabilities at (678) 915-7244 as soon as possible to better ensure that such accommodations are implemented in a timely fashion. Written verification from the KSU Student Disability Services (http://www.kennesaw.edu/stu_dev/dsss/welcome.html) is required.

**HONESTY:** KSU has an Honor Code and a procedure for handling cases when academic misconduct is alleged. All students should be aware of them. Information about the Honor Code and the misconduct procedure may be found at https://web.kennesaw.edu/scai/content/ksu-student-code-conduct.

**NOTE:** The pace may vary, so the following is a weekly rather than daily outline.

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**MATH 4417 Complex Variables**

**TENTATIVE COURSE COVERAGE**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>SECTIONS/TOPICS</th>
<th>HW</th>
<th>DUE</th>
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| Aug 15\(^{th}\)-Aug 17\(^{th}\) | Sums and Products  
Basic Algebraic Properties  
Further Properties  
Moduli  
Complex Conjugates  
Exponential Form | p. 5: 1-5, 10  
p 8: 1,2,4 | Aug 24 |
| Aug 22\(^{nd}\) - Aug 24\(^{th}\) | Exponential Form  
Products and Quotients in Exponential Form  
Roots of Complex Numbers  
Examples  
Regions in the Complex Plane | p. 22: 1, 2, 4, 6, 10  
p. 29: 1, 2b, 3b, 6, 7  
p. 33: 1 | Aug 31 |
| Aug 29\(^{th}\) - Aug 31\(^{st}\) | Functions of a Complex Variable  
Mappings  
Mappings by the Exponential Function | p. 31: 4, 5  
p 37: 1, 3, 4  
p. 44: 1, 3, 4, 7 | Sep 8 |
| Sep 5\(^{th}\) - Sep 7\(^{th}\) Labor Day  
September 2-4 | Limits  
Theorems on Limits  
Limits Involving the Point at Infinity  
Continuity  
**Exam 1** | p. 55: 1ab, 3b, 5, 10, 11 | Sep 14 |
| Sep 11\(^{th}\) - Sep 14\(^{th}\) | Derivatives  
Differentiation Formulas  
Cauchy-Riemann Equations  
Sufficient Conditions for Differentiability | p. 62: 1, 3, 8  
p. 71: 1cd, 2ab, 3 abc, 4b, 5 | Sep 21 |
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<th>Topic</th>
<th>Chapters/Exercises</th>
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<td>Sep 19th - Sep 21st</td>
<td>Polar Coordinates&lt;br&gt;Analytic Functions&lt;br&gt;Examples&lt;br&gt;Harmonic Functions&lt;br&gt;Uniquely Determined Analytic Functions&lt;br&gt;Reflection Principle</td>
<td>p. 77: 1ad, 2abc, 4c, 7 p. 81: 3, 4 p. 87: 3, 4</td>
<td>Sep 28</td>
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<td>Sep 26th - Sep 28th</td>
<td>The Exponential Function&lt;br&gt;The Logarithmic Function&lt;br&gt;Branches and Derivatives of Logarithms&lt;br&gt;Some Identities Involving Logarithms</td>
<td>p. 92: 1, 2, 4, 5, 7 p. 97: 1, 2, 3</td>
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<td>Oct 10th - Oct 12th</td>
<td>Derivatives of Functions&lt;br&gt;Definite Integrals of Functions&lt;br&gt;Contours&lt;br&gt;Contour Integrals&lt;br&gt;Examples&lt;br&gt;Upper Bounds for Moduli of Contour Integrals</td>
<td>p. 121: 2, 4 p. 135: 1, 2, 4 p. 140: 2, 3, 5</td>
<td>Oct 19</td>
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<td>Oct 17th - Oct 19th</td>
<td>Antiderivatives&lt;br&gt;Cauchy-Goursat Theorem&lt;br&gt;Simply and Multiply Connected Domains&lt;br&gt;Cauchy Integral Formula&lt;br&gt;Liouville's Theorem and the Fundamental Theorem of Algebra&lt;br&gt;Maximum Modulus Principle</td>
<td>p. 153: 1ae, f, 2ac, 3, 6, 7 p. 171: 1ab, 2</td>
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<td>Oct 24th - Oct 26th</td>
<td>Convergence of Sequences&lt;br&gt;Convergence of Series&lt;br&gt;Examples&lt;br&gt;Laurent Series</td>
<td>p. 188: 1, 3 p. 196: 2b, 3, 6</td>
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<td>Oct 31st - Nov 2nd</td>
<td>Residues&lt;br&gt;Cauchy's Residue Theorem&lt;br&gt;Using a Single Residue&lt;br&gt;The Three Types of Isolated Singular Points&lt;br&gt;Residues at Poles</td>
<td>p. 239: 1ae, 2, 4 p. 243: 1a, 3 p. 248: 1, 2</td>
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<td>Nov 7th - Nov 9th</td>
<td>Evaluation of Improper Integrals</td>
<td>p. 267: 1, 2</td>
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<td>Linear Transformations&lt;br&gt;The Transformation w = liz&lt;br&gt;Mappings by 1/z&lt;br&gt;Linear Fractional Transformations&lt;br&gt;An Implicit Form&lt;br&gt;Mappings of the Upper Half Plane</td>
<td>p. 313: 1, 2 p. 317: 2, 4</td>
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<td>Nov 28th - Nov 30th</td>
<td>&lt;strong&gt;Review for Final Examination/ FINAL EXAM&lt;/strong&gt;</td>
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