**UTD** University of Texas at Dallas

# Course Syllabus

# Math 3379: Complex Variable
## Fall 2015

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| **Time and Location:** | Tues & Thurs 1:00pm-2:15pm | FO 1.502 |
| **Instructor:** | Wieslaw Krawcewicz | Professor |
| **Contact Information:** | | |
| | • Office: | FO 2.602F |
| | • Phone: | 972-883-6620 |
| | • Email: | wieslaw@utdallas.edu |
| | • Office hours: | Tues & Thurs 2:30:00 pm - 4:00 pm or by appointment. |
| **Prerequisites:** | MATH 2451, MATH 3310 | |

## Course Description:

**MATH 3379 - Complex Variables** (3 semester credit hours) Geometry and algebra of complex numbers, functions of a complex variable, power series, integration, calculus of residues, conformal mapping. Prerequisites: MATH 2451 and MATH 3310. (3-0) S

## References:

- **Main Textbook:** James W. Brown, Ruel V. Churchill, *Complex Variables and Applications*, McGraw Hill, **any edition**.

- **Problem Book:** L. Volkovysky, G. Lunts, I. Armanovich, *Problems in the theory of functions of a complex variable*, Mir Publishers, Moscow (book is out of print, so check out this link http://lib.freescienceengineering.org/view.php?id=293959).

# Homework Assignments:

There will be about 6-8 mandatory graded assignments. Assignments will contribute 20% to your final grade. The homework assignments will be published at our website and you will be given approximately 7 days to complete your solutions. You will be required to hand your homework to your instructor in class on the due-dates. There will be NO late homework accepted.

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# Grading Policy:

- Homework assignments:   20%
- Midterm Exam 1:   25%
- Midterm Exam 2:   25%
- Final Exam:   30%
- Total:   100%

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# Grade Scale:

| A+ | [95…100] | A | [86…94] | A- | [80…85] |
|----|----------|---|---------|----|---------|
| B+ | [75…79] | B | [70…74] | B- | [65…69] |
| C+ | [60…64] | C | [55…59] | C- | [50…54] |
| D+ | [46…49] | D | [44…45] | D- | [42…43] |
| F | [0…41] | | | | |

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# Midterm Exams:

| | Date | Time | Location |
|---|------|------|----------|
| **Midterm Exam 1:** | October 6, 2015 | 1:00–2:15 pm | FO 1.502 |
| **Midterm Exam 2:** | November 5, 2015 | 1:00–2:15 pm | FO 1.502 |

**Exams Rules:** Textbooks, notes, mobile phones, iPhones, scientific calculators or other electronic devises won't be allowed during examination. Rules governing the proper academic conduct and student's integrity will be strictly observed. Cheating and plagiarism won't be tolerated.

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# Final Exam: On December 8 (Tuesday) during the last class, students will be given an examination booklet containing several examination problems covering the course material. Students are supposed to work on these problems at home, individually without collaborating

or consulting with others. On Friday Dec 11, between 10 am - 5 pm, These booklets should be returned to the instructor: office FO 2.602F in Founders Building. Plagiarism won't be tolerated: any suspicious work will be reported directly to Judicial Affairs.

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# Student Learning Objectives:

- Students will learn: algebraic properties of complex numbers, their different representations and geometric properties, complex roots and Cardano's formulae, elementary functions of complex variable and their properties (exponential function, logarithm, trigonometric functions, hyperbolic functions, complex exponents, inverse trigonometric and hyperbolic functions), complex differentiation and its relation to the real differentiation, Cauchy-Riemann equations, complex analytic functions, properties of derivatives, contours in complex domains, contour integrals of complex-valued functions, relations to line integrals, properties of complex integrals, Cauchy-Goursat theorem, Cauchy Integral Formula, derivatives of analytic functions, Liouville's Theorem, Maximum Moduli formula, Taylor series, Laurent series, singularities of analytic functions, residues and Cauchy Residue Theorem, linear fractional transformations, conformal mappings (if possible other selected topics).

- Students will show ability to express complex numbers, complex functions in different forms, to determine analyticity of complex functions, to apply definition and properties of contour integrals to compute concrete integrals, to expand standard analytic functions into Taylor and Laurent series, to determine the type of singularity and the value of the residue for given analytic functions, to apply the residue method for computations of real improper integrals, and to construct conformal mappings between specific domains.

- Students will learn several proofs of classical theorems in complex variable and will apply their knowledge to solve standard problems involving functions of complex variable.

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# Detailed Description of the Course

1. Definition of complex numbers and geometric interpretation. Conjugate numbers and various forms of a complex numbers: vector, polar, standard, trigonometric, exponential, matrix. Properties of complex numbers, argument function, modulus function, DeMoivre formula, complex roots (geometric interpretation), solving cubic equations and Cardano's formulae.

2. Domains and regions in complex plain, point at infinity, functions of complex variable, a concept of multivalued function and its branches, complex elementary functions (exponential function, logarithmic function, trigonometric functions, hyperbolic functions, complex exponents, inverse trigonometric and hyperbolic functions), review of concepts

of continuity and differentiability, complex differentiation and Cauchy-Riemann Equations, analytic functions and analyticity of elementary functions. Properties of complex differentiation.

3. Review of line integrals, contours and definition of complex contour integral, examples and properties of complex line integrals, antiderivatives and formula for evaluation of complex contour integrals, existence of antiderivative of analytic functions, examples of finding antiderivatives of elementary functions, construction of an antiderivative, Cauchy-Goursat theorem, homotopy property of complex line integral, Cauchy Integral Formula, derivatives of analytic function, Liouville's theorem, Maximum Modulus theorem.

4. Sequences and series, Taylor series, Laurent series, examples of finding Taylor and Laurent series, convergence of functional series (absolute, uniform), integration and differentiation of functional series, local representation of an analytic function by a Taylor or Laurent series, multiplication and division of power series.

5. Isolated singular points and their classification, residues, Cauchy Residue Theorem, computational formulae and examples for residues, applications of residues to trigonometric and improper real integrals, examples.

6. Linear fractional transformations and construction of such transformations, conformal mappings and their properties, examples.

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# Additional Information

**Technical Support:** If you experience any problems with your UTD account you may send an email to: assist@utdallas.edu or call the UTD Helpdesk at 972 883-2911.

**Student Conduct & Discipline:** The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations, which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD printed publication, A to Z Guide, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the Rules and Regulations, Series 50000, Board of Regents, The University of Texas System, and in Title V, Rules on Student Services and Activities of the university's Handbook of Operating Procedures. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391) and online at http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

**Academic Integrity:** The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrates a high standard of individual honor in his or her scholastic work.

*Scholastic Dishonesty*, any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

*Plagiarism*, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

**Copyright Notice:** The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials, including music and software. Copying, displaying, reproducing, or distributing copyrighted works may infringe the copyright owner's rights and such infringement is subject to appropriate disciplinary action as well as criminal penalties provided by federal law. Usage of such material is only appropriate when that usage constitutes 'fair use' under the Copyright Act. As a UT Dallas student, you are required to follow the institution's copyright policy (Policy Memorandum 84-I.3-46). For more information about the fair use exemption, see http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm

**Email Use:** The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

**Withdrawal from Class:** The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal

requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

**Student Grievance Procedures:** Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's Handbook of Operating Procedures.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

**Incomplete Grade Policy:** As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of F.

**Disability Services:** The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.

The contact information for the Office of Disability Services is:
The University of Texas at Dallas, SU 22
PO Box 830688
Richardson, Texas 75083-0688
(972) 883-2098 (voice or TTY)
disabilityservice@utdallas.edu

If you anticipate issues related to the format or requirements of this course, please meet with the Coordinator of Disability Services. The Coordinator is available to discuss ways to ensure your full participation in the course. If you determine that formal, disability-related accommodations are necessary, it is very important that you be registered with Disability Services to notify them of your

eligibility for reasonable accommodations. Disability Services can then plan how best to coordinate your accommodations.

It is the students responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

**Religious Holy Days:** The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated. The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee. These descriptions and timelines are subject to change at the discretion of the Professor.