MATH 438.01E (28212) – COMPLEX ANALYSIS

COURSE SYLLABUS: SPRING 2024

(THIS COURSE IS CROSS-LISTED WITH MTE 504.01E)

Office Hours: On-Campus
Monday and Wednesday 9AM–11AM; Tuesday and Thursday 1PM–2PM
or by appointment.
Office Phone: 903-886-5944
Office Fax: 903-886-5945
University Email Address: Mehmet.Celik@tamuc.edu
Preferred Form of Communication: email
Communication Response Time: Student course-related questions or concerns through email are answered usually within 24 hours during weekdays (M-F).
Class Meeting Time: TR 11 am - 12:15 pm (discussions)
Class Location: BINB326

COURSE INFORMATION

MATERIALS

Textbook(s) Required: A First Course in Complex Analysis by Matthias Beck, Gerald Marchesi, Dennis Pixton, and Lucas Sabalka, version 1.54, it is free online at https://matthbeck.github.io/papers/complexorth.pdf. A good source for many solved problems with solutions is Schaum's Outline of Complex Variables, second edition, by Murray R. Spiegel, Seymour Lipschutz, John J. Schiller, and Dennis Spellman, McGraw-Hill, 2009, ISBN 9780071615693. Another good book that we may use is Complex Variables with Applications by Saminathan Ponnusamy and Herb Silverman, Publisher: Birkhäuser; 2006 edition ISBN-10: 0817644571 ISBN-13: 978-0817644574. We may occasionally cover enrichment activities, not in the text.

COURSE DESCRIPTION

This course covers one-dimensional complex analysis, including complex numbers, elementary complex functions, analytic functions, Mobius transformations, integration in the complex plane, and infinite series of complex numbers and variables.

A longer version of the course description: This course covers the elements of one-dimensional complex analysis: The complex numbers (their algebra, geometry, and topology); Analytic functions of a complex variable (definition, examples, properties); complex functions (complex exponential and trigonometric functions, complex logarithm and power functions), Mobius transformations, stereographic

projection; Integration in the complex plane, particularly Cauchy's integral formula and its consequences; Infinite series of complex numbers and complex variables (Taylor and Laurent series). Prerequisites: MATH 2415 Calculus III (Min Grade C) or MATH 314 (Min Grade C).

The following topics are covered in this course:

- The Algebraic and Geometric properties of complex numbers
- Elementary Topology of the complex plane
- The limit and continuity of complex functions
- Complex Differentiability and Holomorphicity
- The Cauchy-Riemann Equations
- Examples of complex functions
- Mobius Transformations (Linear Fractional Transformations) and Cross-Ratio
- Stereographic Projection
- Complex Exponential Functions
- Complex Trigonometric Functions
- Complex logarithm
- Complex power function
- Definition and Basic Properties of Complex Integration
- Cauchy's Theorem
- Antiderivatives
- Cauchy Integral Formula
- Cauchy Integral Formula for derivatives
- Applications of Cauchy Integral formula: Cauchy Estimates, Liouville's Theorem
- Complex Sequences and Complex Series
- Taylor series and Laurent series
- *The residue theorem and the computation of real integrals by complex methods
- *Conformal mapping

***THESE TOPICS ARE OPTIONAL.**

STUDENT LEARNING OUTCOMES

BY THE END OF THE COURSE, STUDENTS SHOULD BE ABLE

1. to ***analyze*** functions of a complex variable using series expansions, using line integrals, using geometry, and using partial differential equations;
2. to ***explain*** the major theorems that distinguish complex analysis from real analysis; and
3. to ***apply*** complex analysis to compute geometric mappings and real integrals.

COURSE REQUIREMENTS

Instructional Methods: The course places a strong emphasis on in-class activities that foster the development of critical thinking skills among students. Prior to class meetings, students will receive information to prepare them for small group problem-solving sessions. These sessions will cover computational,

concept-based, and discussion-oriented problems. During class time, the professor will fully engage students in their own learning by enabling them to think critically, discuss ideas, investigate concepts, and create solutions during group discussions. Students can expect a range of exciting in-class learning activities. Students will submit their work for grading and feedback at the end of each session, with daily participation grades returned at the next meeting.

Course Evaluation Methods

This course will utilize the following instruments to determine student grades and proficiency of the learning outcomes for the course.

Exams – (proctored) There will be two In-term exams. You will have a period of 75 minutes to complete each exam.
Exam 1: Thursday February 15th (Week #6)
Exam 2: Thursday March *28th* (Week #11)
Make-up exams are possible only if there is a documented emergency.

Final Exam: (proctored) A Comprehensive Final Exam (2 hours of exam time).
Final Exam Date: Tuesday, May 7th from 10:30 am to 12:30 pm

Each exam will be proctored in class

Attendance: Regular attendance in class is crucial for earning higher final grades. Active participation and engagement during class discussions are crucial to successful learning. The course material discussed during class is essential for demonstrating proficiency in the subject. It is important for students to inform their instructors of any absences and to make up any missed work. Coordination with fellow students for class notes is recommended if a student cannot attend class. Let's aim for consistent attendance and active participation in class to reach our educational goals.

In-class Participation – During Tuesday and Thursday's class meetings, we will discuss ideas, notions, and problems associated with that week's material. These problems will be distributed at the beginning of each class meeting. At the end of each class, you will submit a number of fully solved problems to receive participation credit for that day (the number will be announced at that day's meeting). You will work in groups but must submit your sheet with the solutions. More information will be provided during the first day of class.

Semester Project: I will provide the necessary material and information about the project after Week 1. Students will be divided into groups. There will be stages in the project with assigned deadlines for submissions. At the end of the semester, each group will give a ten-minute presentation about their findings.

Homework: There will be weekly homework assignments. Each assignment will be graded. Missing questions and answers without work do not earn credit. The questions for a homework assignment will be posted on the weekly module assignment under D2L. The due date for each homework assignment will be

announced with the assignment. Late homework submission won't be accepted.

Submit your homework to the virtual assignment basket located at **[Activities]→[Assignments] →[Homework # on the Assignment Submission Folders]** at D2L as *LastName_FirstName_HW#?_MATH438.pdf* (Example: Celik_Mehmet_HW#2_*MATH438*.pdf).

The homework assignment you submit must be your work. Plagiarism is strictly prohibited.

The key to success: We will use the flipped classroom approach. Students will be more engaged in activities and discussions with their peers during class meetings. With this approach, the professor can provide individual attention to students during class time. Students can learn at their own pace and review materials as needed by accessing them outside of class. This teaching approach encourages collaboration among students as they work through concepts together. In this course, students watch lecture videos (prepared by the professor) before class meetings and then use class time to engage in active learning. Here are suggestions to ensure success in this type of classroom. Finding a quiet and distraction-free environment is essential to ensure you can fully concentrate on video lectures. Keep a notebook and pen nearby to take notes throughout the lecture. To take effective notes, pay close attention to the video, pause the video frequently to take notes, rewind the video if you don't understand something, answer questions in the video, write down questions in your notes, and bring your questions to class or office hours for help and clarification. To participate effectively in class, ask questions, fully participate in class activities, collaborate with peers, offer help to peers, and seek support from peers when needed.

***Workload and Assistance*:** To succeed in this course, it is recommended that you set aside two to three hours each day outside of class to review the material. This includes watching videos, reading, completing homework assignments, and preparing for quizzes and exams. Depending on the week, you may need to allocate more or less time for these tasks. Collaborating with fellow classmates can also be beneficial, so don't hesitate to ask for help or clarification. To further assist you, your professor has reserved specific office hours in Binnion 323. If you have any questions or concerns, feel free to reach out via email. Please note that emails are generally answered within 24 hours during weekdays (M-F).

GRADING

Grading Matrix: This class will be graded on a total points system. 400 points are possible in the class. The following grading matrix presents how your total score is going to be calculated at the end of the semester of Spring 2024 for the *Math 438* course. All the grading instruments are assigned between the first day of class and the last day of class of the Spring 2024 semester. The Final exam is the last grading instrument of the course; the date of the Final Exam is Tuesday, May 7th from 10:30 am to 12:30 pm. The grade is

completely objective and is determined solely by student performance on each of the evaluation criteria (Two Mid-term exams, HW assignments, and the final exam). *Do not expect Extra Credit assignments!*

Instrument	**Value (points)**	**Total**
HW Assignments	At the end of the semester, the average of 10 HW assignments will be considered	40pts
In-class Participation		40pts
Semester Project	A group project	60pts
Mid-term Exams	2 Mid-term exams at 80 points each	160pts
Final Exam	One comprehensive final exam	100pts
Total:		400pts

Grade Determination:

A = 400 – 360 pts; i.e. 90% or better

B = 320 – 359 pts; i.e. 80 – 89 %

C = 280 – 319 pts; i.e. 70 – 79 %

D = 240 – 279 pts; i.e. 60 – 69 %

F = 239 pts or below; i.e. less than 60%

TECHNOLOGY REQUIREMENTS

A computer algebra system will be used for some problem exploration, enhanced conceptual understanding, and to engage students as active participants in the learning process.

- **TI-83/84** or other calculators with similar capability is recommended.
- **Printer** to print homework and tests is recommended.
- **Scanner/digital camera/cell phone** that you can take pictures of your work and submit them to the Dropbox at the eCollege.
- **D2L:** As a student enrolled at Texas A&M University-Commerce, you have access to D2L. You will obtain course materials through D2L, (MyLe→

APPs→ D2L). The course materials are only for this course. You cannot distribute the course materials without permission of the instructor. You also have an email account via myLeo - all my emails sent from D2L (and all other university emails) will go to this account, so please be sure to check your email regularly.

BROWSER SUPPORT

D2L is committed to performing key application testing when new browser versions are released. New and updated functionality is also tested against the latest version of supported browsers. However, due to the frequency of some browser releases, D2L cannot guarantee that each browser version will perform as expected. If you encounter any issues with any of the browser versions listed in the tables below, contact D2L Support, who will determine the best course of action for resolution. Reported issues are prioritized by supported browsers and then maintenance browsers.

Supported browsers are the latest or most recent browser versions that are tested against new versions of D2L products. Customers can report problems and receive support for issues. For an optimal experience, D2L recommends using supported browsers with D2L products.

Maintenance browsers are older browser versions that are not tested extensively against new versions of D2L products. Customers can still report problems and receive support for critical issues; however, D2L does not guarantee all issues will be addressed. A maintenance browser becomes officially unsupported after one year.

Note the following:

- Ensure that your browser has JavaScript and Cookies enabled.
- For desktop systems, you must have Adobe Flash Player 10.1 or greater.
- The Brightspace Support features are now optimized for production environments when using the Google Chrome browser, Apple Safari browser, Microsoft Edge browser, Microsoft Internet Explorer browser, and Mozilla Firefox browsers.

DESKTOP SUPPORT

Browser	Supported Browser Version(s)	Maintenance Browser Version(s)
Microsoft® Edge	Latest	N/A
Microsoft® Internet Explorer®	N/A	11
Mozilla® Firefox®	Latest, ESR	N/A

Browser	Supported Browser Version(s)	Maintenance Browser Version(s)
Google® Chrome™	Latest	N/A
Apple® Safari®	Latest	N/A

TABLET AND MOBILE SUPPORT

Device	Operating System	Browser	Supported Browser Version(s)
Android™	Android 4.4+	Chrome	Latest
Apple	iOS®	Safari, Chrome	The current major version of iOS (the latest minor or **point** release of that major version) and the previous major version of iOS (the latest minor or **point** release of that major version). For example, as of June 7, 2017, D2Lsupports iOS 10.3.2 and iOS 9.3.5, but not iOS 10.2.1, 9.0.2, or any other version. Chrome: Latest version for the iOS browser.
Windows	Windows 10	Edge, Chrome, Firefox	Latest of all browsers, and Firefox ESR.

- You will need regular access to a computer with a broadband Internet connection. The minimum computer requirements are:
    - 512 MB of RAM, 1 GB or more preferred
    - Broadband connection required courses are heavily video intensive
    - Video display capable of high-color 16-bit display 1024 x 768 or higher resolution

- You must have a:

- Sound card, which is usually integrated into your desktop or laptop computer
- Speakers or headphones.
- *For courses utilizing video-conferencing tools and/or an online proctoring solution, a webcam and microphone are required.

- Both versions of Java (32 bit and 64 bit) must be installed and up to date on your machine. At a minimum Java 7, update 51, is required to support the learning management system. The most current version of Java can be downloaded at: JAVA web site http://www.java.com/en/download/manual.jsp

- Current anti-virus software must be installed and kept up to date.

Running the browser check will ensure your internet browser is supported.
Pop-ups are allowed.
JavaScript is enabled.
Cookies are enabled.

- You will need some additional free software (plug-ins) for enhanced web browsing. Ensure that you download the free versions of the following software:
  - Adobe Reader https://get.adobe.com/reader/
  - Adobe Flash Player *(version 17 or later)* https://get.adobe.com/flashplayer/
  - Adobe Shockwave Player https://get.adobe.com/shockwave/
  - Apple Quick Time http://www.apple.com/quicktime/download/

At a minimum, you must have Microsoft Office 2013, 2010, 2007 or Open Office. Microsoft Office is the standard office productivity software utilized by faculty, students, and staff. Microsoft Word is the standard word processing software, Microsoft Excel is the standard spreadsheet software, and Microsoft PowerPoint is the standard presentation software. Copying and pasting, along with attaching/uploading documents for assignment submission, will also be required. If you do not have Microsoft Office, you can check with the bookstore to see if they have any student copies.

ACCESS AND NAVIGATION

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu**.**

NOTE: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a TAMUC campus open computer lab, etc.

COMMUNICATION AND SUPPORT

BRIGHTSPACE SUPPORT

NEED HELP?

STUDENT SUPPORT

If you have any questions or are having difficulties with the course material, please contact your Instructor.

TECHNICAL SUPPORT

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778 or click on the **Live Chat** or click on the words "click here" to submit an issue via email.

SYSTEM MAINTENANCE

D2L runs monthly updates during the last week of the month, usually on Wednesday. The system should remain up during this time unless otherwise specified in an announcement. You may experience minimal impacts to performance and/or look and feel of the environment.

INTERACTION WITH INSTRUCTOR STATEMENT

Student course-related questions or concerns through email are answered usually within 24 hours during week days (M-F). Feedback on assessments will be provided within 7 days after the assignment is submitted.

My primary form of communication with the class will be through the official university Email and Announcements. Any changes to the syllabus or other important information critical to the class will be disseminated to students in this way via your D2L Email address available to me through MyLeo and in Announcements. It will be your responsibility to check your official university Email and Announcements regularly.

Discussions: This space is for students to communicate with each other. I may visit Discussions and join your discussion. Please feel free to answer one another's questions. I will check answers (as well as questions) for correctness, but do not hesitate to respond to a posting if you feel you can answer the question thoroughly and directly.

STUDENT ACADEMIC RESOURCES

Math Lab: Free tutoring service offered by the Mathematics department (Binnion Hall Room 328). Please visit the web site for the hours of operation and more details.
http://www.tamuc.edu/academics/colleges/scienceEngineeringAgriculture/departments/mathematics/students/default.aspx

The TAMUC One Stop Shop - provides as many student resources as possible in one location.
http://www.tamuc.edu/admissions/oneStopShop/

The TAMUC Academic Success Center provides academic resources to help you achieve academic success.
http://www.tamuc.edu/CampusLife/CampusServices/AcademicSuccessCenter/default.aspx

COURSE AND UNIVERSITY PROCEDURES/POLICIES

COURSE SPECIFIC PROCEDURES

Policy for Reporting Problems with eCollege

If students encounter D2L-based problems while submitting assignments and assessments, the following procedures MUST be followed.

1. Students must report the problem to the help desk. You may reach the helpdesk at helpdesk@online.tamuc.org or 1-866-656-5511
2. Students MUST file their problem with the helpdesk and obtain a helpdesk ticket number
3. Once a helpdesk ticket number is in your possession, students should email me to advise me of the problem and to provide me with the helpdesk ticket number
4. At that time I will call the helpdesk to confirm your problem and follow up with you.

PLEASE NOTE: Your personal computer/access problems are not a legitimate excuse for filing a ticket with the help desk. You are strongly encouraged to check for compatibility of your browser BEFORE the course begins and to take the eCollege tutorial offered for students who may require some extra assistance in navigating the eCollege platform. ONLY D2L-based problems are legitimate.

SYLLABUS CHANGE POLICY

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

UNIVERSITY SPECIFIC PROCEDURES

Academic Honesty

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including (but not limited to) receiving a failing grade on the assignment, the possibility of failure in the course and dismissal from the University. Since dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. In ALL instances, incidents of academic dishonesty will be reported to the Department Head. Please be aware that academic dishonesty includes (but is not limited to) cheating, plagiarism, and collusion.

Cheating is defined as:

- Copying another's test of assignment
- Communication with another during an exam or assignment (i.e. written, oral or otherwise)
- Giving or seeking aid from another when not permitted by the instructor
- Possessing or using unauthorized materials during the test
- Buying, using, stealing, transporting, or soliciting a test, draft of a test, or answer key

Plagiarism is defined as:

- Using someone else's work in your assignment without appropriate acknowledgement
- Making slight variations in the language and then failing to give credit to the source

Collusion is defined as:

- Collaborating with another, without authorization, when preparing an assignment

If you have any questions regarding academic dishonesty, ask. Otherwise, I will assume that you have full knowledge of the academic dishonesty policy and agree to the conditions as set forth in this syllabus.

AI use policy

Texas A&M University-Commerce acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course.

Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism).

Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors' guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.

13.99.99.R0.03 Undergraduate Academic Dishonesty
13.99.99.R0.10 Graduate Student Academic Dishonesty

A&M-Commerce Supports Students' Mental Health

The Counseling Center at A&M-Commerce, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit www.tamuc.edu/counsel

ADA STATEMENT

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services

Texas A&M University-Commerce
Gee Library- Room 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu

Website: Office of Student Disability Resources and Services

http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook.
http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum:
Netiquette http://www.albion.com/netiquette/corerules.html

TAMUC Attendance

For more information about the attendance policy please visit the Attendance webpage and Procedure 13.99.99.R0.01.
http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf

Copyright Policy

The handouts used in this course are copyrighted. By "handouts," I mean all materials generated for this course, which include but are not limited to syllabi, lecture notes, quizzes, exams, in-class materials, review sheets, projects, and problems sets. Because these materials are copyrighted, you do not have the right to copy and distribute the handouts.

NONDISCRIMINATION NOTICE

Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age,

genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

CAMPUS CONCEALED CARRY STATEMENT

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the Carrying Concealed Handguns On Campus document and/or consult your event organizer.

Web url:
http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf
Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

COURSE OUTLINE / CALENDAR

WEEKLY SCHEDULE:

Week 1
1.1 Definitions and Algebraic Properties
1.2 From Algebra to Geometry and Back
1.3 Geometric Properties
Week 2
1.4 Elementary Topology of the Plane
2.1 Limit and Continuity
Week 3
2.2 Differentiability and Holomorphicity
Week 4
2.4 The Cauchy-Riemann Equations
2.3 Constant Functions
Week 5
3.1 Mobius Transformations
Week 6 Review & Exam 1
Week 7
3.1 Mobius Transformations (Linear Fractional Transformations)
3.2 Cross Ratio
Week 8
3.3 Stereographic Projection
3.4 Complex Exponential Functions; Complex Trigonometric Functions
Week 9
3.5 Complex Logarithm Function; Complex Power Function
Week 10
4.1 Definition and Basic Properties of Integration
4.3 Cauchy's Theorem
Week 11 Review and Exam 2
Week 12
4.3 Cauchy Theorem - Antiderivatives
4.4 Cauchy Integral Formula
Week 13
5.1 Cauchy Integral Formula For Derivatives
5.2 Taking Cauchy Integral Formula To The Limit: Cauchy's Estimate & Liouville's Theorem
5.3 Anti-Derivatives (Revisited)
Week 14 & Week 15
Chapter 7: Complex Sequences and Series
Week 16 Review

Notes:
Week #1 begins on Wednesday, January 10th, 2024, and the class will be meeting on Thursday.

The week following Week #9 is **Spring Break**, which is from Monday, March 11th, 2024, to Friday, March 15th, 2024. There are no classes during this week.

Week #14 Annual Research Symposium will take place on Wednesday, April 17, 2024, at the Sam Rayburn Student Center, 2nd Floor. Yes, there will be classes on this day.

During **Week #16**, we will meet on April 29th and April 30th, 2024, to review the material for the final exam. May 1st to May 3rd, 2024, are designated as 'Study days'. There will be no exams or assignments on these days.

This schedule is subject to change by the instructor. Any changes to this schedule will be communicated by email and announcements on the course web page.