Mask and Social Distancing Expectations

To ensure a safe learning environment for everyone, masks/face coverings must be worn at all times when inside buildings, including in the classroom, regardless of vaccination status. If a student is not wearing a mask/face covering, they will be asked by the instructor to put one on immediately or leave the classroom. Repeatedly failing to follow this expectation will result in a referral to Community Standards. **Activities that involve temporarily removing the mask, such as eating or drinking are not allowed. Please leave the classroom for such activities**. If I forget to put on my mask/face covering, you should feel comfortable asking me to put one on immediately. Although social distancing will not be required inside classrooms for vaccinated individuals, please be respectful of the wishes of others who prefer to maintain social distancing. For their own protection, unvaccinated individuals are requested to maintain 6 feet social distancing from others at all times.

Initial 2-week period of remote instruction (Jan/18-Jan/29)

As a COVID-19 precaution UConn administration has decided that the first two weeks of classes will be delivered remotely. For this class, the instruction will be mostly **asynchronous (async)** during the period 1/18/22-1/29/22. This means that I will post lectures videos for every day of instruction on HuskyCT. However, the **first class meeting on Wednesday, 1/19/22, will be synchronous (sync)**, and the link will be posted on HuskyCT. Office hours will be held remotely during the entire semester. In the course calendar a synchronous or asynchronous delivery method will always be indicated (sync/async). All Zoom links will be posted on HuskyCT.

UPDATE (01/18/21): based on a recent UConn Town Hall with Interim President Dr. Andrew Agwunobi some changes have been implemented

Math3146 Introduction to Complex Variables – Spring 2022

Course Description: This course focuses on the arithmetic and calculus of complex numbers and functions. We will discuss the properties of analytic functions, including contour integration, Cauchy's integral theorem and formula. Furthermore, we will learn about the representation of functions by Taylor and Laurent series, and how to compute their residues and poles. We will use these techniques in the evaluation of integrals and investigate multivalued functions and singularities. If time permits we will discuss the foundation of conformal mappings. The basic theory of complex variables and functions has important applications for mathematics, physics, and engineering.

Instructor: Andreas Malmendier, Ph.D.
Office: MONT 325, Email: andreas.malmendier@uconn.edu, Phone: 860-486-3844

Lectures: (In-person attendance is recommended but not required.)
Section 001–MoWeFr: 10:10am-11:00am in MONT 421
Section 002–MoWeFr: 1:25pm-2:15pm in Engineering-II 323
As a COVID-19 precaution you may only attend the class for which you are registered.
During the lecture period you will gain expertise in understanding and proving the principles of complex analysis, and solving problems related to these principles. You should come to lecture prepared and participate actively. *The use of cellphones during class is not permitted.*

Office Hours: MoFr: 12:00pm-1:00pm on Zoom – link on HuskyCT

Class Website: `https://huskyct.uconn.edu`
Here you will find the latest information about the course, including the syllabus, lecture videos, homework assignments, supplemental notes, and practice exams with solutions. If you have difficulty accessing HuskyCT, you have access to the in person/live person support options available during regular business hours through the Help Center (live chat, phone, and support documents).

Prerequisites: MATH 2110Q and 2410Q, or MATH 2420Q or 2144Q.

Textbook: "Fundamentals of Complex Analysis with Applications to Engineering, Science, and Mathematics" by E. B. Saff and A. D. Snider, 3rd Ed., Upper Saddle River, Prentice Hall, 1993. ISBN-13: 978-0139078743, ISBN-10: 0139078746
I recommend that you read ahead in your book before coming to class and then again after class before turning to your homework assignment. You can use the detailed and constantly updated class calendar on HuskyCT to see what topic is scheduled for every upcoming class. You may not understand everything on your first reading, but it will help you keep up with the lectures. When reading a math textbook, don't be discouraged if you have to read a passage more than once in order to understand it.

Grading: You should plan to achieve a real mastery of the **Essential Skills** spelled out at the end of this document. These skills are necessary for success in upper division UConn courses.
The final grade will be based on a total score from the weekly *homework*, several *homework-based quizzes*, *midterm exams*, and a cumulative *final exam*. The weighting of your final grade will be 5% from active participation in class and on the HuskyCT discussion board, 35% from 10 *Problem Sets*, 10% from 5 *Quizzes*, 30% from 2 *Midterms*, 20% from a cumulative *Final Exam*. To keep track of your performance in the course, refer to *My Grades* in HuskyCT.
Course letter grades will be assigned according to the scale below. Any curve will be determined at the end of the course, according to the discretion of the instructor. For additional information on undergraduate grading policies see here: `https://registrar.uconn.edu/grades`

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Lower Limit	93	90	87	83	80	77	73	70	67	63	60	0

Active Participation in class and on the discussion board: Active participation is a corner stone for success in this class. 5% of your grade will be based on your participation. You should get into the habit of asking and answering questions to and from your peers and instructor during class, office hours, and discussion sections. On HuskyCT you will find a discussion board which allows you to post your questions and comments. You have to **post at least twice on the discussion board**. Your posting can list the subjects that you are having trouble with or subjects you would enjoy learning more about. Be respectful, kind, and professional at all times!

Homework: There will be **10 weekly problem sets**. Each homework assignment will be posted on HuskyCT a week before its due date. Your homework is always **due on Fridays before 11:59pm** (local time) by email. *Late homework is not acceptable.*
The problems will be linked closely to the lectures, and you should develop the habit of doing the relevant problems between successive lectures rather than completing the whole set the night before it is due. Your homework must be very neat. This means: no messy scratch work, no cramped

writing, no huge eraser marks. The problems must be submitted as **one single PDF file**, and the problems should be in order with their problem number clearly indicated.

Homework-Based Quizzes: There will also be **5 homework-based quizzes**. Quizzes will be given on certain **Wednesdays in class** – the exact dates are listed in the course calendar. For each quiz I will select a few problems from the past-due problem set and ask you to solve these problems. Your solutions will be collected and graded. If you miss a quiz there will be no opportunity to make up the quiz score. However, at the end of the semester the lowest score will be dropped – no questions asked! If you miss more than one quiz, you will need to provide official documentation to avoid a missing quiz score.

Midterm Exams: Midterms are non-cumulative in-class exams and will be held on the following days: **March 2 (Wednesday)** and **April 6 (Wednesday)**. There will be no make-up exams. All exams will take place in person in the class room during lecture period.

Practice Exams/Review Sessions: I will post practice exams and solutions on HuskyCT about a week before each midterm. There will also be virtual review sessions and extra office hours the day before each midterm exam. Details will be posted on HuskyCT.

Final Exam: There will be a *cumulative final examination* during finals week. The exam will be scheduled by UConn. As soon as central administration has decided on our final exam date, I will announce it in class and update the course syllabus.

Extra Credit: There are 2 opportunities to earn extra credit, counted towards your homework grade and listed in the course calendar. An extra-credit opportunity will consist of an additional problem set based on material already taught. If you decide to hand in solutions, they must be fully written solutions and very neat. Submissions follow the same procedure as homework submissions and must be received by **March 21** and **April 29**, respectively.

Group Work: I strongly encourage collaboration in this course, but I insist on honesty about it. If you do your homework in a group, be sure that it works to your advantage rather than against you. So make sure that you really understand the assigned homework. Homework you have not thought through will translate into poor grades on homework-based quizzes and exams. *You also must turn in your own write-ups of all problems, and, if you do collaborate, you need to write the names of your group members on your solution sheet. Failure to do so constitutes plagiarism.*

Academic Honesty: Students should be aware that academic dishonesty (for example, plagiarism, cheating on an examination, misrepresenting someone else's work as one's own, or dishonesty in dealing with a faculty member or other college officials) are particularly serious offenses and will be dealt with severely under dean's discipline. Moreover, a student who knowingly assists another student in committing an act of misconduct shall be equally accountable for the violation, and both shall be subject to the sanctions and other remedies. The work in the quizzes and exams is expected to be your own. In particular, you are forbidden to give or receive help during the exams. *The use of cellphones, calculators, notes, books or formula sheets is also forbidden during all exams.* Please refer to the UConn Student Code on academic honesty for details.

Resources for Students Experiencing Distress: The University of Connecticut is committed to supporting students in their mental health, their psychological and social well-being, and their connection to their academic experience and overall wellness. The university believes that academic,

personal, and professional development can flourish only when each member of our community is assured equitable access to mental health services. The university aims to make access to mental health attainable while fostering a community reflecting equity and diversity and understands that good mental health may lead to personal and professional growth, greater self-awareness, increased social engagement, enhanced academic success, and campus and community involvement.

Students who feel they may benefit from speaking with a mental health professional can find support and resources through the **Student Health and Wellness-Mental Health** (SHaW-MH) office. Through SHaW-MH, students can make an appointment with a mental health professional and engage in confidential conversations or seek recommendations or referrals for any mental health or psychological concern. Mental health services are included as part of the university's student health insurance plan and also partially funded through university fees. If you do not have UConn's student health insurance plan, most insurance plans are also accepted. Students can visit the Student Health and Wellness-Mental Health located in Storrs on the main campus in the **Arjona Building, 4th Floor**, or contact the office at (860) 486-4705, or `https://studenthealth.uconn.edu`.

Accommodations for Illness or Extended Absences: Please stay home if you are feeling ill and please go home if you are in class and start to feel ill. If illness prevents you from attending class, it is **your responsibility to notify me as soon as possible**. You do not need to disclose the nature of your illness, however, you will need to work with me to determine how you will complete coursework during your absence. If life circumstances are affecting your ability to focus on courses, you can email the Dean of Students at dos@uconn.edu to request support.

COVID-19 Specific Information: People with COVID-19 have had a wide range of symptoms reported – ranging from mild symptoms to severe illness. These symptoms may appear 2-14 days after exposure to the virus and can include the following: Fever, Cough, Shortness of breath or difficulty breathing, Chills, Repeated shaking with chills, Muscle pain, Headache, Sore throat, loss of taste or smell. Additional information including what to do if you test positive or you are informed through contract tracing, and answers to other important questions can be found here: `https://studenthealth.uconn.edu/updates-events/coronavirus`

Students with Disabilities: The University of Connecticut is committed to protecting the rights of individuals with disabilities and assuring that the learning environment is accessible. Students who require accommodations should contact the Center for Students with Disabilities (CSD).

How to Succeed in this Course: All students can succeed in this course and I am here to help you along the way. Please do not hesitate to ask questions or attend office hours. All questions are important here. Success in this course program depends heavily on your personal health and well-being. Recognize that stress is an expected part of the college experience, and it often can be compounded by unexpected setbacks or life changes outside the classroom. I strongly encourage you to reframe challenges as an unavoidable pathway to success. Reflect on your role in taking care of yourself throughout the semester, before the demands of exams and projects reach their peak. **Please feel free to reach out to me about any difficulty you may be having** that may impact your performance in your courses or campus life as soon as it occurs and before it becomes too overwhelming. In addition to your academic advisor, I strongly encourage you to contact the many other support services that stand ready to assist you.

For many of you, this course will involve more conceptual and abstract ideas than you are not used to seeing in mathematics classes. This will take some adjustment, and now is the best time to develop the habits that will help you succeed. These include carefully completing all readings and assigned homework before class, actively participate by asking and answering questions to and from your peers and instructor (during class, office hours, and discussion sections), and engaging with your work and the work of others to revise and improve it, for example, by completing the weekly problem sets in a study group.

Evaluation of Course Experience: Students will be given an opportunity to provide feedback on their course experience and instruction using the University's standard procedures, which are administered by the Office of Institutional Research and Effectiveness (OIRE). The University of Connecticut is dedicated to supporting and enhancing teaching effectiveness and student learning using a variety of methods. Additional informal formative surveys and other feedback instruments will be administered within the course.

Student Support Services:

- **Dean of Students** 486-3426, dos@uconn.edu

  The office serves as an advocate for students and as a centralized resource for connecting students with appropriate university and community programs, offices and individuals. The office supports students in resolving educational, personal and other university concerns that affect the quality of their academic or community life and personal goals.

- **Center for Students with Disabilities** 486-2020 (voice), 486-2077 (TDD)

  The Center for Students with Disabilities (CSD) at UConn provides accommodations and services for qualified students with disabilities. If you have a documented disability for which you wish to request academic accommodations and have not contacted the CSD, please do so as soon as possible: Wilbur Cross Building, Room 204 or `http://csd.uconn.edu`

- **Counseling and Mental Health Services** 486-4705 (after hours, use 486-3427)

- **Alcohol and Other Drug Services** 486-9431

Essential Skills: Complex Variables and Functions

You should strive for personal mastery over the following skills:

1. Perform arithmetic operations with complex numbers using both rectangular and polar forms.
2. Use properties of analytic functions, including identifying and differentiating various common analytic functions.
3. Evaluate and apply properties of contour integrals (directly/using Cauchy's integral formula).
4. Identify and compute a function's Taylor and Laurent series.
5. Perform residue calculus and use it with applications.

MATH 3146 – Course Calendar – Spring 2022 (subject to change: last updated 01/18/2022)

Day	Month	Day	#	Topic: **complex algebra**	Reading
W	Jan	19	1	*sync:* Introduction, applications of complex analysis `(link on HuskyCT)`	
F	Jan	21	2	*async:* Algebra of complex numbers, polar form of complex numbers	1.1-1.3
M	Jan	24	3	*async:* Complex exponentials, Euler's formula	1.4
W	Jan	26	4	*async:* Roots of unity, principal roots	1.5
F	Jan	28	5	*async:* Constructible polygons, trigonometric identities	1.5
F	Jan	28		**Problem-Set 1 due**	
M	Jan	31	6	Riemann sphere, extended complex plane	1.7
W	Feb	2	7	Stereographic projection, Fubini-Study metric	1.7
F	Feb	4	8	Topology of complex plane	1.6
F	Feb	4		**Homework-Based Quiz 1 in class**	
F	Feb	4		**Problem-Set 2 due**	

Day	Month	Day	#	Topic: **holomorphic functions**	Reading
M	Feb	7	9	Functions of one complex variable	2.1
W	Feb	9	10	Limits and continuity in the complex plane	2.2
F	Feb	11	11	$\mathbb{C}$-differentiability, Cauchy-Riemann equations	2.3
F	Feb	11		**Problem-Set 3 due**	
M	Feb	14	12	Holomorphic functions, Wirtinger differentials	2.4
W	Feb	16	13	Harmonic functions, harmonic conjugates	2.5
F	Feb	18	14	Holomorphic functions as conformal maps	2.5
F	Feb	4		**Homework-Based Quiz 2 in class**	
F	Feb	18		**Problem-Set 4 due**	
M	Feb	21	15	Complex logarithm, principal branch	3.2
W	Feb	23	16	Branch cuts, Riemann surface: complex logarithm	3.3
F	Feb	25	17	Branch cuts, Riemann surface: fractional complex powers	3.5
F	Feb	25		**Problem-Set 5 due**	
M	Feb	28	18	Branch cuts, Riemann surface: inverse trigonometric functions	3.5
Tu	Mar	1	19	Review Session, 4-6pm `(link on HuskyCT)`	
W	Mar	2	20	**Exam 1 covering lectures #1-17**	

Day	Month	Day	#	Topic: **complex integration**	Reading
F	Mar	4	21	Contour integrals, winding number	4.2
M	Mar	7	22	Path independence of contour integrals	4.3
W	Mar	9	23	Relation to vector calculus, Morera's theorem	4.4
F	Mar	11	24	Cauchy's integral theorem	4.4
F	Mar	11		**Homework-Based Quiz 3 in class**	
F	Mar	11		**Problem-Set 6 due**	
MWF	Mar	14-18		Spring Break – No class	
M	Mar	21		**Extra-Credit Problem-Set due**	
M	Mar	21	25	Consequences of Cauchy's integral theorem	4.4
W	Mar	23	26	Cauchy's integral formula	4.5
F	Mar	25	27	Generalized Cauchy's integral formula	4.5

F	Mar	25		**Problem-Set 7 due**	
M	Mar	28	28	Bounds for holomorphic functions, Liouville's theorem	4.6
W	Mar	30	29	Maximum modulus principle, argument principle	4.6
Day	Month	Day	#	Topic: **Laurent series and residue calculus**	Reading
F	Apr	1	30	Series: radius of convergence, absolute convergence; power series	5.1, 5.2
F	Apr	1		**Homework-Based Quiz 4 in class**	
F	Apr	3		**Problem-Set 8 due**	
M	Apr	4	31	Uniform convergence of power series	
Tu	Apr	5	32	Review Session online `(link on HuskyCT)`	
W	Apr	6	33	**Exam 2 covering lectures #15-30**	
F	Apr	8	34	Uniform convergence of power series, Weierstrass M-test	5.3
M	Apr	11	35	Taylor series, Hermite formula for remainder	5.2
W	Apr	13	36	Laurent series	5.5
F	Apr	15	37	Laurent series: different regions of expansion	5.6
F	Apr	15		**Problem-Set 9 due**	
M	Apr	18	38	Isolated singularities: poles, essential singularities	5.7
W	Apr	20	39	Residue theorem	6.1
F	Apr	22	40	Integrals over the unit circle (Type-I), improper integrals (Type-II)	6.2
F	Apr	22		**Homework-Based Quiz 5 in class**	
F	Apr	22		**Problem-Set 10 due**	
M	Apr	25	41	Improper integrals (Type-III), Cauchy principal value	6.3
W	Apr	27	42	Simple poles on the path of integration (Type-IV)	6.4
F	Apr	29	43	Kramers-Kronig relations, inverse Laplace transform	
F	Apr	29		**Extra-Credit Problem-Set due**	
TBA				**Comprehensive final exam in lecture hall**	