

## Course Syllabus – Fall 2022

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### Course Information

<i>Course Prefix, Number, Section</i>	MATH 6390.001
<i>Course Title</i>	Kähler Manifolds
<i>Term</i>	Fall 2022
<i>Days &amp; Times</i>	MW 2:30pm - 3:45pm
<i>Room</i>	SLC 1.202

### Professor Contact Information

<i>Professor</i>	Ronan Conlon
<i>Email Address</i>	ronan.conlon@utdallas.edu
<i>Office Location</i>	PHY 1.910
<i>Office Hours</i>	MW 5:15pm – 6:45pm or by appointment

### Course Pre-requisites, Co-requisites, and/or Other Restrictions

MATH 2418 and MATH 4341

### Course Description

Complex manifolds are higher-dimensional surfaces that are defined using the complex numbers. A "metric" on such a space is an object that endows that space with a shape or more precisely, with Ricci curvature. The study of these metrics lies at the nexus of complex geometry and geometric analysis. A "Ricci-flat Kahler manifold" is a complex manifold endowed with a special type of metric with vanishing Ricci curvature, commonly referred to in the literature as a "Calabi-Yau manifold". Applications of such manifolds permeate throughout physics and mathematics. Indeed, Calabi-Yau manifolds of complex dimension three have become prominent in string theory where they supposedly model the six additional real dimensions of space-time that we do not see. This led to the idea of mirror symmetry. Essentially, Calabi-Yau manifolds are shapes that satisfy the requirement of space for the six "unseen" spatial dimensions of string theory, which may be smaller than our currently observable lengths as they have not yet been detected. In this course we will understand precisely what is meant by a "Kahler manifold" and a "Calabi-Yau manifold", culminating in an exposition of Yau's famous proof of the Calabi conjecture for which he was awarded the Fields medal in 1982.

### Required Textbooks and Materials

#### *Required Texts*

A. Moroianu, *Lectures on Kähler Geometry*, London Mathematical Society Student Texts Book 69

Textbooks and some other bookstore materials can be ordered online or purchased from the [UT Dallas Bookstore](#).

## Other Resources

### *Riemannian geometry*

- M. do Carmo, *Riemannian Geometry*, Birkhäuser
- S. Gallot, D. Hulin, J. Lafontaine, *Riemannian Geometry*, Springer (3rd ed.)
- J. Jost, *Riemannian Geometry and Geometric Analysis*, Springer-Verlag (6th ed.)
- S. Kobayashi, K. Nomizu, *Foundations of Differential Geometry*, Wiley Classics Library
- J. Lee, *Introduction to Smooth Manifolds*, Graduate Texts in Mathematics, 218, Springer-Verlag (2nd ed.)
- J. Lee, *Riemannian Manifolds: An Introduction to Curvature*, Graduate Texts in Mathematics, 176, Springer-Verlag
- I. Madsen and J. Tornehave, *From Calculus to Cohomology: De Rham Cohomology and Characteristic Classes*, Cambridge University Press
- P. Petersen, *Riemannian Geometry*, Graduate Texts in Mathematics, 171, Springer-Verlag (3rd ed.)

### *Kähler geometry*

- P. Griffiths, J. Harris, *Principles of Algebraic Geometry*, Wiley Classics Library
- D. Huybrechts, *Complex Geometry: An Introduction*, Springer
- G. Székelyhidi, *An Introduction to Extremal Kähler Metrics*, Graduate Studies in Mathematics, 152, AMS

## Assessment

- **Homework:** There will be weekly mandatory selectively graded assignments. Assignments will contribute 35% to your final grade. A serious and steady effort to work out all of the homework problems is highly recommended. The homework assignments will be published on eLearning (Assignments tab) and you will be given approximately 7 days to complete your solutions. To receive credit for a problem, students must show all of the work including reasoning leading to the final answer. A correct answer without work deserves zero credit. Timely completion of homework is essential for success in this class. You will be required to hand in your homework to your instructor in class on the due dates. **Late homework will not be accepted.** Missed assignments will be zeroes.
- **Exams:** There will be one final exam. This will be conducted orally during the last week of the semester and will contribute 60% to your final grade.

## Grading Policy

- 5% Attendance
- 35% Homework assignments
- 60% Final Exam

## Grading Scale

The final letter grade will be based on your total cumulative percentage which will be computed as follows:

[93-100]	A	[90-93]	A-		
[87-90]	B+	[83-87]	B	[80-83]	B-
[77-80]	C+	[70-77]	C		
Below 70	F				

## Important Dates

- Monday, September 5: Labor Day
- Wednesday, September 7: Last day to drop a class without a “W”
- Tuesday, October 4: WL Begins
- Tuesday, November 8: WL Ends
- Monday, November 21 – Wednesday, November 23: Fall break
- Last week of semester: Final Exam

## Course Policies

### *Extra Credit*

N/A

### *Late Work*

All students are expected to submit the homework and take the examinations at the announced time. A zero will be assigned for any missed or late work.

### *Special Assignments*

N/A

### *Class Attendance*

Required.

### *Classroom Citizenship*

Required. Any action which disturbs your classmates or interrupts the lecture is unacceptable.

## Classroom Conduct Requirements Related to Public Health Measures

UT Dallas will follow the public health and safety guidelines put forth by the Centers for Disease Control and Prevention (CDC), the Texas Department of State Health Services (DSHS), and local public health agencies that are in effect at that time during the Fall 2021 semester to the extent allowed by state governance. Texas Governor Greg Abbott's Executive Order [GA-38](#) prohibits us from mandating vaccines and face coverings for UT Dallas employees, students, and members of the public on campus. However, we strongly encourage all Comets to get vaccinated and wear face coverings as recommended by the CDC. Check the [Comets United: Latest Updates webpage](#) for the latest guidance on the University's public health measures. Comets are expected to carry out [Student Safety](#) protocols in adherence to the Comet Commitment. Unvaccinated Comets will be expected to complete the [Required Daily Health Screening](#). Those students who do not comply will be referred to the Office of Community Standards and Conduct for disciplinary action under the [Student Code of Conduct – UTSP5003](#).

## Class Attendance

Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty.

## Class Participation

Regular class participation is expected. Students who fail to participate in class regularly are inviting scholastic difficulty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

## **Class Recordings**

Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the [Student Code of Conduct](#).

The instructor may record meetings of this course. These recordings will be made available to all students registered for this class if the intent is to supplement the classroom experience. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law.

## **Comet Creed**

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

“As a Comet, I pledge honesty, integrity, and service in all that I do.”

## **Academic Support Resources**

The information contained in the following link lists the University’s academic support resources for all students.

Please see <http://go.utdallas.edu/academic-support-resources>.

## **UT Dallas Syllabus Policies and Procedures**

The information contained in the following link constitutes the University’s policies and procedures segment of the course syllabus. Please review the catalog sections regarding the [credit/no credit](#) or [pass/fail](#) grading option and withdrawal from class.

Please go to <http://go.utdallas.edu/syllabus-policies> for these policies.

*The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.*