# Special Topics Courses Fall 2026

**MA 493-001/591-006 Representation Theory of Groups**
If you wondered how abstract group theory could be used further in mathematics or in the physical world, you might find an answer through representations. A representation of a group is a way of representing each group element as an invertible matrix. This perspective allows us to study groups via linear maps, and it also gives us the language to study how groups act on other mathematical objects. The philosophy of studying objects via the powerful tools of linear algebra is ubiquitous in mathematics, and representation theory does this as well. In this course, we will introduce representations of groups, discuss many examples of representations of groups you have secretly seen before, study the building blocks of representations, prove Schur's lemma, describe "character tables", and more as time permits. If you enjoyed linear algebra and group theory, this might be the next course for you!
**Prerequisites:** MA405 and MA407
**Instructor:** Dr. Maitreyee Kulkarni | mckulkar@ncsu.edu
**When:** Mondays, Wednesdays and Fridays
**Time:** 1:55 PM - 2:45 PM

**MA 591-001 (Future 512) Introduction to Analysis**
Euclidean space R^n (topology, norms, inner products, continuous functions, contractions, homeomorphisms). Spaces and sequences of functions (Weierstrass theorem, convergence of Fourier series). Differentiation and integration in finite dimensions (partial derivatives, inverse functions, implicit functions, optimization, higher-order derivatives, Fubini's theorem, Change of Variables theorem). Differential forms. Integration of differential forms (Submanifolds of R^n, Stokes's theorem, relation to classical vector calculus).
**Prerequisites:** MA405 and MA 425 (or MA511)
**Instructor:** Dr. Peter McGrath | pjmcgrat@ncsu.edu
**When:** Tuesdays and Thursdays
**Time:** 10:15 AM - 11:30 AM

**591-002 (Future 516) Measure and Integration Theory**
The course is an introduction to measure theory and Lebesgue integration. The topics covered include Sigma algebras and measurable sets, measures, measurable functions, Lebesgue integration, Lebesgue spaces, and product measures.
**Prerequisite:** MA 425
**Instructor:** Dr. Tien Khai Nguyen | tnguye13@ncsu.edu
**When:** Tuesdays and Thursdays
**Time:** 1:30 PM -2:45 PM

**MA 591-003 (Future 517) Complex Analysis**
This course intends to cover topics in classical complex analysis with more emphasis on rigor, abstraction, and connections to other parts of mathematics. Topics of discussion include: properties of holomorphic functions, the Cauchy integral formula, the Cauchy residue theorem, classification of singularities, the Hadamard factorization theorem, and conformal mappings and the Riemann mapping theorem. The textbook we will cover will be Complex Analysis by Stein and Shakarchi.
**Students must have already completed MA 425** prior to enrolling in this course.
**Instructor:** Dr. Zane Li | zkli@ncsu.edu
**When:** Tuesdays and Thursdays
**Time:** 11:45 AM - 1:00 PM

**MA 591-004 (Future 538) Applied Harmonic Analysis**
Applied Harmonic Analysis studies the theory and modern extensions of Fourier analysis, with an emphasis on its role in data representation and analysis across diverse fields such as engineering, medicine, and finance. Applications include signal and image processing, denoising, data compression, and image reconstruction. Topics include Fourier series, the Fourier transform, the discrete and fast Fourier transforms (DFT/FFT), interpolation and sampling theory, wavelet analysis, and the discrete wavelet transform with applications. The course emphasizes the mathematical foundations underlying these methods, as well as the development and implementation of practical algorithms.
**Prerequisites**: Undergraduate level Linear Algebra (equivalent of MA 305 or MA 405). Familiarity with Differential Equations (MA 341 or MA 401) is desired. The students are expected to have basic programming experience in Matlab.
**Instructor:** Dr. Fatma Terzioglu | fterzioglu@ncsu.edu
**When:** Tuesdays and Thursdays
**Time:** 3:00 PM - 4:15 PM

**591-005 (BMA 590) Introduction to Fluid Mechanics**
This course will offer an introduction to fluid dynamics and its applications in biology. The course will study fluid mechanics from a mathematical perspective, including examples from biological applications. The equations of fluid mechanics will be derived from first principles, and areas of active research will be discussed. The course is suitable for advanced undergraduate students and graduate students in mathematics, physics, engineering, and mathematical biology. Students will work on an independent project that can be taken from their research. Topics will include physical concepts such as viscosity, vorticity, viscous flow, shock waves, wave propagation, stokes flow, boundary layers, and potential flow. Biological applications will include swimming, flying, and blood flow in networks of arteries.
**Background needed:** Basic understanding of mechanics, vector calculus, matrices, ordinary differential equations. Other mathematics and physics will be reviewed as needed.
**Instructor:** Dr. Mette Olufsen | msolufse@ncsu.edu
**When:** Tuesdays and Thursdays
**Time:** 1:30 PM - 2:45 PM

**MA 591-007 Mathematical Foundations of Quantum Computation**

This course offers a mathematically rigorous introduction to quantum computation, focusing on foundational concepts from both classical and quantum perspectives. In an era where quantum technologies are transitioning from theoretical physics to engineering reality, this coursework serves as a bridge into the world of quantum information science by dissecting core principles—superposition, entanglement, and interference—through the precise language of Hilbert spaces, tensor products, and linear operators. Designed for students seeking a broad understanding or preparing for deeper study, the curriculum exposes students to how quantum computation is formulated and understood. The primary goal is to facilitate the in-depth mathematical knowledge required for advanced research in the field, emphasizing the structural transition from classical bit-based logic to the unitary evolution of quantum states.

**Prerequisite**: MA405

I**nstructor:** Dr. Moody Chu | mtchu@ncsu.edu

**When:** Mondays and Wednesdays

**Time:** 3:00 PM - 4:15 PM