

MATH 6701 Syllabus

Mathematical Methods of Applied Sciences I

Sections A and Q (3 credits)

Fall Semester Academic Year 2026-2027

Instructor Information

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General Course Information

Description

There is a general course description/syllabus page for this course at <https://math.gatech.edu/courses/math/6701>

This course is intended as a review of mathematical topics for a graduate student beginning his studies and especially as preparation for the second course (MATH 6702) in the sequence covering topics in partial differential equations familiarity with which may be expected during graduate studies but with which many students are not familiar.

The review topics/subjects are

- 1. linear algebra (covered in MATH 1551)*

Note: The prerequisite courses MATH 3406 (A Second Course in Linear Algebra) and MATH 4305 (Topics in Linear Algebra) listed in the administrative course description are probably inappropriate. The correct course to require for a prerequisite is probably MATH 1551, but this is probably not listed because graduate students cannot take MATH 1551. In any case, it is assumed (at least administratively) that students in MATH 6701 have some familiarity with linear algebra so as to benefit from a review. Historically speaking this is the case (among students in the course). If a student knows absolutely nothing about linear algebra, this course is probably inappropriate for that student.

2. ordinary differential equations (covered in MATH 2552)

It may be noted similarly that if a student has never had any previous course in ordinary differential equations and is consequently unable to benefit from a review of that subject, then this is not an appropriate course for that student. It may be possible in certain instances that a student may not have taken a previous course in ordinary differential equations (or linear algebra) but can learn such subjects for the first time in the context of the review of this course. This happens sometimes, and the instructor is not opposed to that.

In addition to the two reviewed subjects (linear algebra and ordinary differential equations) an elementary introduction to the subject called **complex analysis** is given. Complex numbers $z = x + iy$ arise as solutions of certain algebraic equations like $x^2 + 1 = 0$ or $x^2 + 2x + 2 = 0$, and there are many other applications of complex numbers. Most students are familiar with complex numbers and some of their properties and various related formulas, but few students have actually taken a course in complex analysis which is really about complex functions (by which is meant a complex valued function of a complex variable).

A basic introduction is given in this course touching on

1. complex mapping properties (which can be viewed as a natural extension of the complex arithmetic with which most students are familiar).
2. complex power series (a generalization of Taylor series from calculus)
3. complex differentiability (which is somewhat like differentiability from calculus but has some very different features) Included here are some first examples of partial differential equations, namely the Cauchy-Riemann equation and Laplace's equation.
4. complex integration (There are a couple different flavors each of which generalizes integration from calculus.)

Finally, these topics are somewhat tied together in a discussion of Riemann surfaces and delineation of branches of complex functions. This material can be very useful in, for example, understanding the output from various standard functions available via implementation in mathematical software.

Course Learning Outcomes

Upon completion of this course you will have had the opportunity to review the subject of linear algebra. (You should be able to find the eigenvalues of

a matrix and know what they mean. You should know what a vector space is and appreciate what it means to have a basis for a vector space or change that basis. You should be able to diagonalize a matrix if it can be diagonalized and determine if it cannot and why.)

Upon completion of this course you will have had the opportunity to review the subject of ordinary differential equations (ODE). (You should know/remember how to solve some elementary ODEs. You should know/remember something about the linear theory of ODEs and the use of Laplace transforms. You should be able to execute a basic phase plane analysis for an autonomous system of ODEs---and of course remember what it means for an ODE to be autonomous or nonautonomous. You should know/remember the basic facts of existence and uniqueness for ODEs.)

You will almost certainly also have the opportunity to learn some new things about linear algebra and ODEs you never learned before or did not appreciate fully or at all. For example, many students do not understand the “big picture” concerning existence and uniqueness of solutions and why “every” ODE is equivalent to an autonomous first order system. Many students have not solved an ODE using power series or considered complex solutions or used variational techniques. You may know about and appreciate things like this when you finish this course.

Perhaps the most important (technical) “outcome” of taking this course might fall into this category: If you haven’t yet learned to find numerical approximations of solutions of ODEs using mathematical software (specifically “canned” adaptive fourth and fifth order Runge-Kutta methods) then you shouldn’t let yourself get past this semester without being able to do that. Many students have not yet acquired that skill before taking this course.

And of course this course offers the opportunity to learn some complex analysis. You should know what a complex function is and the basics of how to visualize such a function using mapping techniques and Riemann surfaces. You should know how complex differentiation works and how it differs from real differentiation. You should know what the Cauchy-Riemann equations are and how they are related to complex differentiation.

Required Course Materials

Textbook:

Mathematical Methods in the Physical Sciences (third edition)

by Mary Boas

Grading Policy:

Approximately 10 assignments are made available to a student during the semester. Each assignment has a due date. **After the due date** some subset of the problems will be identified/designated for grading. If a student has submitted a solution to one of the identified problems **before the due date** then that solution will be graded. The grade will include both comments giving feedback on the student's solutions and a score. A percentage score for the entire assignment will then be calculated based on the entire subset of identified/designated problems.

A student must submit, i.e., upload to Canvas, solutions by the due date in order to expect his work to be graded and to receive a score.

At the end of the semester a percentage score will be tabulated from the assignment scores (each of which is weighted equally), and the course grade is assigned according to the following scheme:

A (90-100%) B (80-89%) C (70-79%) D (60-69%) F (below 60%)

Any deviation from the above description may be discussed with the instructor.

Description of Graded Components

Each Assignment will be posted for at least two weeks before the due date. The final assignment will have a due date of the date of the final exam for the course (though the grading and weighting for that particular assignment will not differ in other ways from the previous assignments due during the regular instructional days).

Assignment due dates will be no less than one week apart. Put another way, no two assignments will be due the same week. It should be noted however that while an assignment will be posted for at least two weeks before the due date, there will not be two weeks between every pair of due dates. There

will be (many) instances in which one assignment is due exactly one week after the previous assignment.

Each assignment may be viewed as requiring approximately ten hours to complete in a reasonable manner. This will vary from student to student. If a student cannot submit neat and readable solutions for the assignment by the due date, then he should discuss his situation with the instructor.

Course Policies

Attendance and/or Participation

Attendance is not graded. Participation is appreciated.

Academic Integrity

Some kind of integrity is appreciated.

Accommodations for Students with Disabilities

If you are a student with learning needs that you feel require special accommodation, please e-mail me in order to set up a time to discuss your learning needs.

