



§ I: MATH 6611 Matrix Theory and its Applications Syllabus

Catalog Description

Prerequisite: undergraduate linear algebra or permission of instructor. Review of matrix algebra, systems of linear equations and rank; linear algebra in n -dimensions; inner product spaces and orthogonality; eigenvalues and eigenvectors; Hermitian, unitary, and normal matrices; quadratic and Hermitian forms. The course covers topics in matrix theory needed for significant applications in engineering and computer science. 3 credits.

This course covers a broad range of topics that are relevant to graduate students majored in applied sciences, including engineering and computer science. It introduces fundamental mathematical concepts and methods, and encourages students to apply these materials in their major studies. A solid background in Calculus (I-III) and linear algebra is necessary. Further knowledge in differential equations is recommended but not necessary.

Required Textbook

Advanced Engineering Mathematics, E. Kreysig, John Wiley, 10e, ISBN **9781111827052** (2011).

Course Objectives

This course covers a broad range of topics that are relevant to graduate students majored in applied sciences, including engineering and computer science. It introduces fundamental mathematical concepts and methods, and encourages students to apply these materials in their major studies. A solid background in Calculus (I-III) and linear algebra is necessary. Further knowledge in differential equations is recommended but not necessary.

Student Learning Outcomes

After successfully completing this course the expectation is that students will be able to:

1. Analyze and apply appropriate methods for of solution of first, second and higher order linear ODEs, systems of ODEs and construct series solutions of ODEs with the help of special functions;
2. Categorize concepts of linear algebra, conduct matrix operations, and solve and apply matrix eigenvalue problems;
3. Apply Fourier analysis techniques to solve three important PDEs: heat equation, wave equation and Laplace equation.
4. Examine basic operations on the field of complex numbers, interpret the analytic properties of complex functions, formulate harmonic conjugate using Cauchy-Riemann Equations, and integrate complex functions using Cauchy's Integral Theorem.

Required Curriculum Content

This course introduces important mathematical concepts that are useful in engineering sciences, including ordinary different equations (ODEs), partial differential equations (PDEs), Laplace transforms, Fourier transforms, eigenvalue problems, complex analysis, and linear algebra. Finally, a brief introduction to numerical linear algebra is given at the end of the course. This course does not focus on the mathematical rigor behind

theories, but emphasizes the applications of mathematical ideas to practical examples in engineering and computer sciences. Students are expected to apply the course materials in their major studies in the future.

All sections of MATH 6611 Matrix Theory and its Applications will cover, as a minimum, the material from *Advanced Engineering Mathematics*, E. Kreysig, John Wiley, 10e, ISBN **9781111827052** (2011), as listed:

Chapter	Textbook Topic
1	First-Order ODEs
1.5	Linear ODE
2	Second Order Linear ODEs
2.1	Homogeneous linear ODEs of second order
2.2	Homogeneous linear ODEs with constant coefficients
2.7	Non-homogeneous ODEs
2.9	Modeling:Electrical circuits
4	Systems of ODEs
4.1	Systems of ODEs as models in engineering applications
6	Laplace Transform
6.1	Laplace transforms, 1st shifting theorem
6.2	Transforms of derivatives and integrals, ODEs
6.3	Unit step function, 2nd shifting theorem
6.4	Short impulses, Dirac Delta function
6.5	Convolution, Integral equations
7	Linear Algebras
7.1	Addition and scalar multiplication of matrices
7.2	Matrix multiplication
7.3	Linear systems of equations,, Gauss elimination
7.4	Linear independence, rank, vector space
7.6	Second and 3rd order determinants
7.7	Determinants, Cramer's rule
7.8	Inverse of a matrix, Gauss-Jordan elimination
7.9	Vector spaces, Inner product spaces, linear transformation
8	Matrix Algebra and Eigenvalue Problems
8.1	Determining eigenvalues and eigenvectors
8.2	Applications of Eigenvalue problem
8.3	Symmetric, skew symmetric and orthogonal matrices
8.4	Eigenbases, diagonalization, quadratic forms
8.5	Complex matrices and forms
13	Complex Differentiation
13.1	Complex numbers
13.2	Polar form, powers, roots
13.3	Derivative, analytic function
13.4	Cauchy-Riemann equations, Laplace equation
13.5	Exponential functions
13.6	Trigonometric and hyperbolic functions, Euler's formula
13.7	Logarithm, general power, principal value
14	Complex Integration
14.1	Complex line integral
14.2	Cauchy's integral theorem
14.3	Cauchy's integral formula

Chapter	Textbook Topic
14.4	Derivatives of analytic functions
15	Power Series, Taylor Series
15.2	Power series
15.3	Functions given by power series
15.4	Taylor series
16	Laurent series, residue integration
16.1	Laurent series
16.2	Singularities and zeros
16.3	Residue integration
16.4	Residue integration of real integrals, including Fourier integrals
18	Complex Potential Theory
18.1	Electrostatic fields
20	Numerical Linear Algebra
20.1	Least squares method

Common Department Requirements for MATH 6611

While students in each section of MATH 6611 are assessed by the course instructor, there are general guidelines that apply to all sections of MATH 6611. These include:

- Calculators and other electronic devices are not allowed on any exams.

Department, College and University Expectations and Policies

It is important that students familiarize themselves with a range of policies and guidelines that have been established by the Department of Mathematics and Physics, the College of Arts and Sciences, and the University of New Haven. These are an integral part of the syllabus for this course.

Adding/Dropping a Class

The final day to drop a course without it appearing on your transcript is Tuesday, December 4, as discussed at <http://www.newhaven.edu/academics/calendar>. During the second week of classes, further adjustment requires the approval of the chair of the department offering the course, as described at <http://catalog.newhaven.edu/content.php?catoid=7&navoid=730#Changes>.

Attendance Regulations

University attendance policy guidelines require that:

All students are expected to attend regularly and promptly all their classes, appointments, and exercises. While the university recognizes that some absences may occasionally be necessary, these should be held to a minimum. A maximum of two weeks of absences will be permitted for illness and emergencies. The instructor has the right to dismiss from class any student who has been absent more than the maximum allowed. After the last date to drop as published in the academic calendar, a student will receive a failure (F), if failing at that point, or a W, if passing at the time of dismissal.

Students are to adhere to the policy attendance policy guidelines outlined in the University Catalog under the heading, *Attendance Regulations*, at http://catalog.newhaven.edu/content.php?catoid=12&navoid=881#Academic_Status_and_Progress, or alternatively in the Student Handbook at <http://www.newhaven.edu/studenthandbook> on pp. 48-49, i.e., at <http://viewer.zmags.com/publication/bc83d17d#/bc83d17d/48>.

Withdrawal Deadline

Students wishing to withdraw must submit a request for an official course withdrawal in writing using the Course Withdrawal Form available online from <http://forms.newhaven.edu/view.php?id=134169>. The final date to request a withdrawal is Tuesday, October 30 listed in <http://www.newhaven.edu/academics/schedules-registration/academic-calendar-2017-2018.php>. This request must be submitted to the Registrar's Office and signed by the International Office if you are an international student. The grade of W will be recorded, but the course will not affect the GPA.¹

Incomplete Grades

A grade of Incomplete (INC) is given only in special circumstances and indicates that the student has been given permission by the instructor to complete required course work (with the same instructor) after the end of the term. Students need to examine carefully the **changed guidelines** pertaining to INC grades, specifically:

To remove the INC grade, the student must complete all required course work in timely fashion as stipulated by the instructor but no later than the end of the following term. Fall and intersession course incompletes must be completed no later than the last day of the spring term. Spring and summer course incompletes must be completed no later than the last day of the fall term.

If the course work is not submitted within the allotted time, the INC grade will be changed to an F shortly after the deadline by the Office of the University Registrar. Students will be notified via campus email at least two weeks prior to the change of grade process.

The University policy on incomplete grades is available at http://catalog.newhaven.edu/content.php?catoid=12&navoid=881#Academic_Status_and_Progress under the heading, *Incomplete (INC) Grade Policy*.

¹ Please note that this withdrawal deadline represents a **significant policy change**. It is the responsibility of the student to assure that the required paperwork and documentation is completed by the deadline.

Academic Integrity Policy

This class fully adheres to the Academic Integrity Policy:

Academic integrity is a core university value that ensures respect for the academic reputation of the University, its students, faculty and staff, and the degrees it confers. The University expects that students will conduct themselves in an honest and ethical manner and respect the intellectual work of others. Please be familiar with the UNH policy on Academic Integrity. Please ask about my expectations regarding permissible or encouraged forms of student collaboration if they are unclear.

Students are required to adhere to the Academic Integrity Policies specified in the Student Handbook on pp. 66–73 of <http://www.newhaven.edu/studenthandbook>, i.e., at <http://viewer.zmags.com/publication/bc83d17d#bc83d17d/66>.

Coursework Expectations

This course will require significant in-class and out-of-class commitment from each student. The University estimates that a student should expect to spend two hours outside of class for each hour they are in a class. For example, a three credit course would average six [6] hours of additional work outside of class.² Coursework expectations are detailed at http://catalog.newhaven.edu/content.php?catoid=12&navoid=881#General_Policies under the heading *Course Work Expectations*.

Please note, that MATH 6611 is a 3-credit course, and as such requires a total of 9 hours per week invested in study and homework for the average student.

Commitment to Positive Learning Environment

The University of New Haven wants to foster and support a civil, respectful, and open-minded climate so that all of us can live and work in an environment free of harassment, bias-motivated behaviors, unfair treatment, and fear. To this end, the university expects all members of our community to refrain from actions or behaviors that intimidate, humiliate, or demean persons or groups or that undermine their security or self-esteem based on traits related to race, ethnicity, country of origin, religion, gender identity/expression, sexual orientation, age, or physical or mental ability, including learning and/or developmental disabilities and past/present history of mental disorder or other category protected by state or federal law. If you have witnessed or are the target of a bias-motivated incident, please contact the Office of the Dean of Students at 203-932-7432 or Campus Police at 203-932-7014 or fill out the form at <http://www.newhaven.edu/student-life/report-it>.

The University adheres to the philosophy that all community members should enjoy an environment free of any form of harassment, sexual misconduct, discrimination, or intimate partner violence. If you have been the victim of sexual misconduct we encourage you to report this. If you report this to a faculty/staff member, they must notify our college's Title IX coordinator about the basic facts of the incident (you may choose to request confidentiality from the University). If you encounter sexual harassment, sexual misconduct, sexual assault, or discrimination based on race, color, religion, age, national origin, ancestry, sex, sexual orientation, gender identity, or disability please contact the Title IX Coordinator, Caroline Koziatek at (203)-932-7479 or CKoziatek@newhaven.edu. Further information about Title IX at UNH may be found at <http://www.newhaven.edu/about/title-ix.php/>.

Religious Observance Policy for Students

The University of New Haven respects the right of its students to observe religious holidays that may necessitate their absence from class or from other required university-sponsored activities. Students who wish to observe such holidays should not be penalized for their absence, although in academic courses they are responsible for making up missed work. More information about religious observance policies can be found in the Student Handbook on p.48 at <http://viewer.zmags.com/publication/bc83d17d#bc83d17d/48>.

More information about religious observance policies can be found in the Student Handbook, and there is also a separate handbook for International students at <https://www.newhaven.edu/student-life/international-service>

² Please note that study guidelines are important, i.e., there is substantial evidence that shows that the pass rates for students in math courses decrease dramatically as the time spent on outside study falls below 2 hours of homework per credit per week.

[index.php](#).

University Support Services

The University recognizes students often can use some help outside of class and offers academic assistance through several offices. In addition to discussing any academic issues you may have with your instructor, advisor, or with the the courses or department coordinator or chair, the University provides these additional resources for students:

The Academic Success Center

<http://www.newhaven.edu/AcademicSuccess>, located in Maxcy 208 for help with your academic studies, or call 203.932.7234 to set up an appointment.

The Center for Learning Resources (CLR)

<http://www.newhaven.edu/academics/CLR>. located in Peterson Library, provides academic content support to the students of the University of New Haven using metacognitive strategies that help students become aware of and learn to apply optimal learning processes in the pursuit of creating independent learners CLR tutors focus sessions on discussions of concepts and processes and typically use external examples to help students grasp and apply the material.

Writer to Writer

<http://www.newhaven.edu/writertowriter/> is a peer-tutoring program inspired by the belief that all writers struggle and can benefit from talking through their ideas. Tutors are undergraduate students trained to work with you at any stage in the writing process.

Accessibility Resources Center

<http://www.newhaven.edu/student-life/accessibility-resources-center/index.php>. Students with disabilities are encouraged to share, in confidence, information about needed specific course accommodations. The Accessibility Resources Center (ARC) provides comprehensive services and support that serve to promote educational equity and ensure that students are able to participate in the opportunities available at the University of New Haven. Accommodations cannot be made without written documentation from the ARC. The ARC is located on the ground floor in the rear of Sheffield Hall. Sheffield Hall is located in the Residential Quad area, and can be contacted at 203-932-7332. The ADA/Section 504 Compliance Officer is Rebecca Johnson, RJohnson@newhaven.edu, and can be reached by phone at 203-932-7238. Information on the ARC can be found at