Shih Chien University

STP Program (Dec 22-Jan 16)

MATH 220 Differential Equations and Linear Algebra

Course Outline

Course Code: MATH 220

Instructor: Vadim Olshevsky

Home Institution: University of Connecticut

Office Hours: TBA

Email: olshevsky@gmail.com

Credits: 4

Class Hours:

This course will have 144 class hours, including 50 lecture hours, professor 30 office hours, 20-hour TA discussion sessions, 10-hour review sessions, 34-hour extra classes.

Prerequisites: Calculus II

Course Description:

This course explores two cornerstone areas of applied mathematics: linear algebra and differential equations. Together, these subjects offer powerful methods for describing and solving problems that arise in disciplines such as science, engineering, and business. Students will engage with linear algebra through topics like vector spaces, linear dependence and independence, matrices, and eigenvalues/eigenvectors. They will also study differential equations, examining concepts such as solution existence and uniqueness, first- and second-order equations (both homogeneous and non-

homogeneous), higher-order equations, systems of linear differential equations, the heat equation, and practical applications that connect theory to real-world scenarios.

Course Objectives:

The primary aim of this course is to build a strong foundation in linear algebra, differential equations, and the practical applications of differential equations. By the end of the course, students should be able to identify when these mathematical tools are appropriate, determine how to apply them effectively, and explain the reasoning and implications of their results in real-world contexts. Along the way, the course emphasizes the development of analytical thinking, critical reasoning, problem-solving abilities, and clear communication. Mastery of the core concepts and methods will enable students to both understand the theoretical underpinnings and appreciate the practical value of differential equations. This preparation will also serve as a stepping stone for further studies in fields such as science, engineering, and business.

Required Course Materials:

1) David C. Lay, Steven Lay, and Judy McDonald, Linear Algebra and Its Applications (5th ed., Pearson, 2016).

Do not purchase this book before the first class. The instructor will share a direct link to the publisher's MyLab platform, where it can be obtained at a discounted price along with access to the online homework system.

2) William E. Boyce and Richard C. DiPrima, Elementary Differential Equations and Boundary Value Problems (11th ed., Wiley, 2018).

Do not purchase this book before the first class. The instructor will provide a direct link to the publisher's WileyPLUS platform, offering a discounted price and access to the online homework system.

Homework:

Online homework assignments for each section of the textbook will be administered through WebAssign. Assignments will be released several days before the corresponding section is discussed in class. Due dates, determined by the instructor, will typically fall two to three days after the material is covered. Each question will allow up to five submission attempts.

Grading & Evaluation:

Attendance and participation:	10%
Homework:	30%
Midterm:	30%
Final:	30%

Grading System (1 ~ 100):

A+ : 96 - 100	A : 91 - 95
B+ : 86 - 90	B : 81 - 85
C+ : 76 - 80	C : 71 - 75
D+ : 66 - 70	D : 60 - 65
F : 0 - 59	
Pa : Pass	Fa : Fail

Course Schedule

Week 1 – Linear Algebra

Introduction to linear systems, matrices, Gaussian elimination, reduced row echelon form, matrix operations, inverses, determinants, vector spaces, linear combinations, span, independence, subspaces, bases, and dimension.

Week 2 – Differential Equations (Part I)

Existence and uniqueness of solutions; first-order linear, separable, exact, and Bernoulli equations; modeling with ordinary differential equations.

Week 3 – Differential Equations (Part II)

Second-order homogeneous and nonhomogeneous equations; the mass–spring problem; higher-order equations; Laplace transforms and solutions of initial value problems; power series solutions.

Week 4 – Differential Equations (Part III)

Systems of linear ordinary differential equations; Fourier series; introduction to partial differential equations, with emphasis on the heat equation.

Detailed Course Outline:

Week 1 – Linear Algebra

Introduction to linear systems (1.1)

Matrices and matrix operations (1.2–1.4)

Gaussian elimination (1.5)

Reduced row echelon form (1.6)

Determinants and matrix inverses (1.7)

Eigenvalues and eigenvectors (1.8)

Vector spaces and linear combinations (2.1–2.2)

Span and linear independence (2.3–2.4)

Subspaces, bases, and dimension (2.5–2.6)

Week 2 – Differential Equations (Part I)Existence and uniqueness of solutions (3.1)

First-order linear and separable equations (3.2)

Exact and homogeneous first-order equations (3.3)

Special integrating factors, substitutions, and Bernoulli equations (3.4)

Modeling with first-order differential equations (3.5)

Exam 1

Week 3 – Differential Equations (Part II)

Second-order homogeneous equations (4.1)

Non-homogeneous equations (4.2)

The mass–spring problem (4.3)

Higher-order equations (4.4)

Laplace transforms and solutions of initial value problems (4.5)

Power series solutions of initial value problems (4.6)

Exam 2

Week 4 – Differential Equations (Part III)

Systems of linear ordinary differential equations (5.1)

Fourier series (6.1)

Introduction to partial differential equations, with emphasis on the heat equation (6.2)

Final Exam and review session

Student Responsibilities and Expectations

Course content will be delivered primarily through lectures, supplemented by a weekly discussion session held every Friday, where students can review material and work through assigned problems with a teaching assistant (TA). Students are expected to keep up with the pace of the course by attending both lectures and discussion sessions regularly, completing homework assignments on time, and dedicating adequate study hours to master the material. If a class is missed, students should promptly obtain the notes and review the missed topics. Active engagement is encouraged—students should ask questions and seek help whenever needed to stay on track.

Examinations

The assessment will include two midterm exams and one comprehensive final exam. Exam formats will include problem-solving questions, definitions, concise explanations of concepts, and short proofs.