MATH 613: Advanced Applied Mathematics I: Modeling
Fall 2021 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

COURSE INFORMATION

Course Description: Concepts and strategies of mathematical modeling are developed by investigation of case studies in a selection of areas. Consistency of a model, nondimensionalization and scaling, regular and singular effects are discussed. Possible topics include continuum mechanics (heat and mass transfer, fluid dynamics, elasticity), vibrating strings, population dynamics, traffic flow, and the Sommerfeld problem.

Number of Credits: 3

Prerequisites: MATH 331 and MATH 337, or departmental approval.

Course-Section and Instructors:

Course-Section	Instructor
Math 613-001	Professor Y.-N. Young

Office Hours for All Math Instructors: Fall 2021 Office Hours and Emails

Required Textbook:

There is no required textbook for this course. Please see the recommended text below:

- J. David Logan: Applied Mathematics, 4th Edition, Wiley, ISBN# 978-1118475805

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Wednesday, November 10, 2021**. It will be strictly enforced.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Assignments	25%
Midterm Exam	35%
Final Exam	40%

Your final letter grade will be based on the following tentative curve.

A	84 - 100	**C+**	60 - 69
B+	77 - 83	**D**	50 - 59
B	70 - 76	**F**	0 - 49

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced.

Homework: Homework is assigned each week, and is expected to be handed in on time. Late submissions will be penalized.

Exams: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

Midterm Exam	October 28, 2021
Final Exam Period	December 15 - 21, 2021

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

Makeup Exam Policy: To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

http://math.njit.edu/students/policies_exam.php

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Fall 2021 Hours)

Further Assistance: For further questions, students should contact their instructor. All instructors have regular

office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

https://www.njit.edu/studentsuccess/accessibility/

Important Dates (See: Fall 2021 Academic Calendar, Registrar)

Date	Day	Event
September 1, 2021	Wednesday	First Day of Classes
September 4, 2021	Saturday	Saturday Classes Begin
September 6, 2021	Monday	Labor Day
September 8, 2021	Wednesday	Monday Classes Meet
September 8, 2021	Wednesday	Last Day to Add/Drop Classes
November 10, 2021	Wednesday	Last Day to Withdraw
November 25 to November 28, 2021	Thursday to Sunday	Thanksgiving Recess - Closed
December 10, 2021	Friday	Last Day of Classes
December 13 and December 14, 2021	Monday and Tuesday	Reading Days
December 15 to December 21, 2021	Wednesday to Tuesday	Final Exam Period

Course Outline

Date	Topic
Sept. 2	Introduction to modeling. Units, dimensions, and dimensional analysis.
Sept. 8	Nondimensionalization: examples from various models
Sept. 9	Nondimensionalization: the Buckingham’s Π theorem
Sept. 13	ODE models in 1D: stability analysis and the phase line

Sept. 16	ODE models in 2D: linear stability analysis and the phase plane; diagonalization
Sept. 20	ODE models in 2D: vector calculus review, conservative fields, Lyapunov functions
Sept. 23	ODE models in 2D: chemical reactions and the principle of mass action
Sept. 27	ODE models in 2D: SRI model for infectious disease propagation in a population
Sept. 30	ODE models: perturbation methods, asymptotic series
Oct. 4	ODE models: perturbation methods, asymptotic series (continued)
Oct. 7	PDE models in R´R+: random walks and the diffusion equation.
Oct. 11	PDE models in R´R+: equilibrium solutions of diffusion equation
Oct. 14	PDE models in R´R+: traffic modeling, method of characteristics for hyperbolic PDEs
Oct. 18	PDE models in R´R+: method of characteristics continued; shocks
Oct. 21	Einstein notation: vector and tensor operations
Oct. 25	Einstein notation: partial differentiation, product rules, higher-order derivatives
Oct. 28	**Midterm Exam**
Nov. 1	PDE models in R3: Divergence Theorem and the continuity equation
Nov. 4	PDE models in R3: Maxwell's equations, EM wave in vacuum, electrostatics
Nov. 8	PDE models in R3: Electrostatics (continued)
Nov. 11	PDE models in R3: reaction-diffusion equations, conservation laws, cell calcium dynamics
Nov. 15	PDE models in R3: incompressible flows, inviscid and viscous fluid flows, 2D flows
Nov. 18	PDE models in R3: Navier-Stokes Equation
Nov. 22	PDE models in R3: Navier-Stokes Equation: derivation
Nov. 29	Stochastic processes: continuous-time Markov processes
Dec. 2	Stochastic processes: Chemical Master Equations (CMEs) and moment equations
Dec. 6	Stochastic processes: solving CMEs using the generating function
Dec. 9	Stochastic processes: finding the generating function using the method of characteristics

Updated by Professor Y.-N. Young - 8/17/2021
Department of Mathematical Sciences Course Syllabus, Fall 2021