MATH 613: Advanced Applied Mathematics I: Modeling
Fall 2019 Graduate Course Syllabus

Recommended Textbook (there is no *required* textbook for this course):

J. David Logan "Applied Mathematics" 4th Edition (Wiley) 2013
ISBN 978-1-118-47580-5 / ISBN 978-1-118-51492-4 / ISBN 978-1-118-51493-1

Grading Policy: The final grade will consist of the following components:

Assignments	25%
Midterm Exam	35%
Final Exam	40%

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

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

Homework Policy: 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 31, 2019
Final Exam Period	December 16 - 20, 2019

Policy on Academic Integrity:

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

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

Math 613-001 • Fall 2019 • COURSE OUTLINE • Prof. Victor Matveev

Date	Topic
Sep 5	Introduction to modeling. Units, dimensions, and dimensional analysis.
Sep 9	Nondimensionalization: examples from various models
Sep 12	Nondimensionalization: the Buckingham's Π theorem
Sep 16	ODE models in 1D: stability analysis and the phase line
Sep 19	ODE models in 2D: linear stability analysis and the phase plane; diagonalization
Sep 23	ODE models in 2D: vector calculus review, conservative fields, Lyapunov functions
Sep 26	ODE models in 2D: chemical reactions and the principle of mass action
Sep 30	ODE models in 2D: SRI model for infectious disease propagation in a population
Oct 3	ODE models: perturbation methods, asymptotic series
Oct 7	ODE models: perturbation methods, asymptotic series (continued)
Oct 10	PDE models in $R \times R^+$: random walks and the diffusion equation.
Oct 14	PDE models in $R \times R^+$: equilibrium solutions of diffusion equation
Oct 17	PDE models in $R \times R^+$: traffic modeling, method of characteristics for hyperbolic PDEs
Oct 21	PDE models in $R \times R^+$: method of characteristics continued; shocks
Oct 24	Einstein notation: vector and tensor operations
Oct 28	Einstein notation: partial differentiation, product rules, higher-order derivatives
Oct 31	**Midterm Exam**
Nov 4	PDE models in R^3: Divergence Theorem and the continuity equation
Nov 7	PDE models in R^3: Maxwell's equations, EM wave in vacuum, electrostatics
Nov 11	PDE models in R^3: Electrostatics (continued)
Nov 14	PDE models in R^3: reaction-diffusion equations, conservation laws, cell calcium dynamics
Nov 18	PDE models in R^3: incompressible flows, inviscid and viscous fluid flows, 2D flows
Nov 21	PDE models in R^3: Navier-Stokes Equation
Nov 25	PDE models in R^3: Navier-Stokes Equation: derivation
Nov 26	Stochastic processes: continuous-time Markov processes
Dec 2	Stochastic processes: Chemical Master Equations (CMEs) and moment equations
Dec 5	Stochastic processes: solving CMEs using the generating function
Dec 9	Stochastic processes: finding the generating function using the method of characteristics