Comprehensive Course Syllabus

Course Title
Differential Equations

Course Description:
This course is intended to give a broad introduction to the study of differential equations. DE's will be viewed and studied as a way to model and predict a wide variety of phenomena such as population growth, spread of a disease, harmonic oscillation, etc. Models will be studied analytically, numerically, and graphically. Technology will be used throughout the course to help gain a deeper understanding of the model and its solutions, either exact or approximate.

INSTRUCTOR:

- Name: Patrick Davis
- Office Number: A157
- Telephone number: 630-907-5492
- Email address: pdavis@imsa.edu

Meeting Days, Time and Room
1:20 pm, A151

Text / Materials:
Differential Equations, 4th edition, 2012, Blanchard, Devaney, and Hall, Cengage Learning. ISBN 13: 978-1-133-10903-7
Mathematica, Wolfram Research, Inc.

Essential Content:

Almost all of the IMSA Mathematics Learning Standards are addressed in one form or another within this course. By their nature, differential equations are used to model a wide variety of situations. We will study many models – why they are written as they are, what they tell us about current situations, and what they tell us about the future. While we will learn analytic techniques to solve a number of types of DEs, solutions to many equations can only be approximated, and this will be done most efficiently with the use of technology. We will relate the analytic, numerical, and graphical forms of these models, moving from one representation to another depending on the information desired. And when we have those representations, it will be important for the student to explain and communicate what they see, understand, and predict.

Instructional Design and Approach:
Students will be asked to learn using a variety of strategies. These will vary with the day and the topic. (Listed in no specific order):

- Reading the text.
- Direct instruction and class discussions.
- Working in groups during class time on problems and models.
- Working individually and/or with others outside of class on problems and models.
- Using technology to examine solutions and to vary parameters.
- Presentations given by classmates.

Student Expectations:
It is expected that students will be engaged in class work and class discussions at all times. This includes being respectful of the questions and needs of other students in the class. Students are expected to be on time to class. Arriving late or missing class will be handled as designated in the Student Handbook. Grades for late assignments will be lowered. The penalty will depend on the timing and the reasons. Academic honesty will be discussed regularly, and cases of dishonesty will be brought to the attention of Mr. McIntosh.

Assessment Practices, Procedures, and Processes:
1. Written, in-class, assessments will be given about every two weeks. These will cover basic skills and conceptual understanding. The frequency will be used to encourage students to stay current with the material. More importantly, developing fundamental skills and understanding individually is essential to allow continued growth and maturation in the subject area. (53.33%)
2. Work done or prepared outside of class where students are allowed to get help from other students or from the instructor. This work will include problem sets, assignments or projects based on computer work and explanations, some longer problems with written explanations, and some small presentations. (26.67%)
3. Final exam. (20%)

Sequence of Topics and Activities
The number of days given for each topic is approximate. This number includes assessments. The text introduces and then reuses many models as the concepts are expanded. Thus, models, ideas, and skills are intertwined throughout the text. Computer visualizations and animations will be used each week.

Days	Topics
1 – 8	(Sections 1.1 – 1.4) Intro to modeling and what a differential equation is using examples from exponential growth, logistic growth, mixing, and predator-prey systems. Review of separation of variables, slope fields, and Euler's Method.
9 – 12	(Sec 1.5 – 1.6) Existence of solutions. Equilibrium solutions and phase lines.

13 – 15	(Sec 1.7) Bifurcation.
16 – 21	(Sec 1.8 – 1.9) Linear equations and solutions.
22 – 26	(Sec 2.1 – 2.2) Systems of equations.
27 – 32	(Sec 2.3 – 2.5) Harmonic oscillators and more on systems. Euler's method for systems.
33 – 34	(Sec 2.7) SIR model.
(if time)	(Sec 2.8) Lorenz equations and chaos.
35 – 37	(Sec 3.1 – 3.2) Systems of linear equations.
38 – 43	(Sec 3.2 – 3.5) Phase planes and Eigenvalues.
44 – 48	(Sec 3.6 – 3.7) Extensions of linear equations.
49 – 53	(Sec 4.1 – 4.2) More on harmonic oscillators.
54 – 59	(Sec 5.1 – 5.2) Exploring non-linear systems.
60 – 64	(Sec 6.1 – 6.2) Laplace Transforms.
65 – 66	Semester review.