NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 473: Intermediate Differential Equations
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.

COURSE INFORMATION

Course Description: Topics in the qualitative behavior of solutions of ordinary differential equations with applications to engineering problems. Includes phase plane analysis, stability, dynamical systems, and chaos. Effective From: Spring 2009.

Number of Credits: 3

Prerequisites: Math 222 with a grade of C or better and Math 337 with a grade of C or better.

Course-Section and Instructors

Course-Section	Instructor
Math 473-001	Professor C. Diekman

Required Textbook:

Title	Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry and Engineering
Author	S. Strogatz
Edition	2nd
Publisher	Westview Press
ISBN #	978-0813349107
Notes	(1st edition of textbook is also acceptable)

University-wide Withdrawal Date: Please note that the last day to withdraw with a W is November 3, 2014. It will be strictly enforced.

COURSE GOALS

Course Objectives

- Students should (a) learn about the qualitative behavior of solutions of ordinary differential equations; (b) learn geometric techniques for the study of dynamical systems, including stability analysis, bifurcation theory, phase portraits and limit cycles; and (c) gain experience with discrete and chaotic dynamical systems.
- Students should gain an appreciation for the importance of nonlinear dynamics in science and engineering applications.
- Students should gain experience in the use of software programs to perform numerical integration, continuation, and visualization of solutions.

Course Outcomes

- Students have improved geometrical thinking and qualitative problem-solving skills.
- Students have a greater understanding of the importance of nonlinear dynamics in science and technology.
- Students are prepared for further study in mathematics as well as science, engineering, computing, and other areas.

Course Assessment: The assessment of objectives is achieved through homeworks, exams, and a final project.

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:

Homework	25%
Midterm Exam I	25%
Midterm Exam II	25%
Final Project	25%

Your final letter grade will be based on the following tentative curve. NOTE: When assigning your final letter grade for the course, class attendance and participation may be considered.

A	90 - 100	C	60 - 69
B+	85 - 89	D	51 - 59
B	75 - 84	F	0 - 50

C+	70 - 74		

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 and Project Requirements: Homework assignments will be announced in class and posted on the course website. The due date will typically be one week from the day it is assigned. Homework not turned in at the beginning of class on the due date will be considered late and penalized 10%. An additional 10% penalty will be applied each subsequent day that a homework assignment is late. Students are encouraged to work together in groups and discuss the problems with each other, but each student must write up and submit an individual set of solutions. Please write out your solutions neatly (or type them) and staple the sheets together.

The course project consists of a written report (4-6 pages, due December 10) and an oral presentation (during the university assigned Final Exam time for Math 473). You may work individually or in groups of 2 or 3. For group work, only one grade will be assigned for the whole group.

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

Midterm Exam I	October 6, 2014
Midterm Exam II	November 10, 2014
Final Exam	December 15 - 19, 2014

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: There will be NO MAKE-UP EXAMS during the semester. In the event the Final Exam is not taken, under rare circumstances where the student has a legitimate reason for missing the final exam, a makeup exam will be administered by the math department. In any case the student must notify the Math Department Office and the Instructor that the exam will be missed and present written verifiable proof of the reason for missing the exam, e.g., a doctors note, police report, court notice, etc., clearly stating the date AND time of the mitigating problem.

ADDITIONAL RESOURCES

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed at the Math Department link. Teaching Assistants are also available in the Math Learning Center.

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

Important Dates (See: Fall 2014 Academic Calendar, Registrar)

Date	Day	Event
September 2, 2014	T	First Day of Classes
September 8, 2014	M	End of Add/Drop Period
November 3, 2014	M	Last Day to Withdraw
November 25, 2014	T	Thursday Classes Meet
November 26, 2014	W	Friday Classes Meet
November 27 - 30, 2014	R - S	Thanksgiving Recess Starts
December 10, 2014	W	Last Day of Classes
December 11 & 12, 2014	R & F	Reading Days
December 15 - 20, 2014	M - S	Final Exam Period

Course Outline

Date	Class	Sections	Topic	Assignment
9/3	1	Chap. 1	Introduction, Overview, Review	Sel. Probs.
9/8	2	2.0 – 2.2, 2.4	Fixed Points and Stability	Sel. Probs.
9/10	3	2.3, 2.5, 2.6 – 2.8	Population Dynamics, Potentials and Numerics	Sel. Probs.
9/15	4	3.0 – 3.3	Saddle-Node and Transcritical Bifurcations	Sel. Probs.
9/17	5	3.4 – 3.7	Pitchfork and Imperfect Bifurcations	Sel. Probs.
9/22	6	Chap. 4	Vector Fields on the Circle	Sel. Probs.
9/24	7	5.0-5.1	2D Linear Systems	Sel. Probs.
9/29	8	5.2-5.3	Classification of Linear Systems	Sel. Probs.
10/1	9	----------	Review for Midterm Exam I	----------
10/6	10	----------	MIDTERM EXAM I	----------
10/8	11	6.0 – 6.2	Phase Portraits	Sel. Probs.
10/13	12	6.3 – 6.4	Fixed Points and Linearization	Sel. Probs.
10/15	13	6.5 – 6.7	Conservative Systems	Sel. Probs.
10/20	14	Chap. 7	Limit Cycles	Sel. Probs.
10/22	15	Notes	Applications	Sel. Probs.

10/27	16	8.0 – 8.1	2D Bifurcations	Sel. Probs.
10/29	17	8.2 – 8.3	Hopf Bifurcation	Sel. Probs.
11/3	18	8.4 – 8.5	Global Bifurcations	Sel. Probs.
11/5	19	----------	Review for Midterm Exam II	Sel. Probs.
11/10	20	----------	MIDTERM EXAM II	Sel. Probs.
11/12	21	8.6	Quasiperiodicity	Sel. Probs.
11/17	22	8.7	Poincaré Maps	Sel. Probs.
			FINAL PROJECT ASSIGNED, DUE 12/10	
11/19	23	9.0 – 9.1	Introduction to Chaos	Sel. Probs.
11/24	24	9.3 – 9.6	Lorenz Equations	Sel. Probs.
11/26			NO CLASS (FOLLOW FRIDAY SCHEDULE)	----------
12/1	25	10.5 – 10.6	Logistic Map	Sel. Probs.
12/3	26	Chap. 11	Fractals and Fractal Dimensions	Sel. Probs.
12/8	27	12.0 – 12.3	Strange Attractors	Sel. Probs.
12/10	28	12.4 – 12.5	Examples of Chaos	Sel. Probs.
			FINAL PROJECT WRITTEN REPORT DUE	
12/15 - 12/20			FINAL PROJECT ORAL PRESENTATIONS (during the university assigned Final Exam time for Math 473)	