NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 373: Introduction to Mathematical Biology
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: This course provides an introduction to the use of mathematical techniques applied to problems in biology. Discrete and continuous models of biological phenomena will be discussed. Biological topics discussed range from the subcellular molecular systems and cellular behavior to physiological problems, population biology and developmental biology. Techniques of phase plane analysis for differential equations are introduced in the course. No prior background in biology is necessary. Effective From: Spring 2009.

Number of Credits: 3

Prerequisites: Math 211 with a grade of C or better or 213 with a grade of C or better or 213H 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 373-002	Professor C. Diekman

Required Textbook:

Title	*Mathematical Models in Biology*
Author	Edelstein-Keshet
Edition	---
Publisher	SIAM

ISBN #	0-89871-554-7
Required Software	MATLAB

University-wide Withdrawal Date: Please note that the last day to withdraw with a W is **March 30, 2015**. It will be strictly enforced.

COURSE GOALS

Course Objectives

- Be able to understand and solve discrete and continuous models of biological phenomena.
- Be able to understand biological models published in the scientific literature.
- Be able to develop and solve discrete and continuous biological models given descriptions of biological systems.

Course Outcomes

- Students have improved geometrical thinking and qualitative problem-solving skills.
- Students have a greater understanding of mathematical modeling as a means of unifying related concepts.
- Students are prepared for further study in mathematics and biology.

Course Assessment: The assessment of objectives is achieved through homeworks, exams, and a 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 and Quizzes	25%
Project	15%
Midterm Exam	25%
Final Exam	35%

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

A	90 - 100	**C**	70 - 74
B+	85 - 89	**D**	60 - 69
B	80 - 84	**F**	0 - 59
C+	75 - 79		

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 collected one week after assignment in class; NO EXCEPTIONS.

Quiz Policy: There will be a 5 minute written quiz at the beginning of certain lectures on Wednesdays.

Project: There will be one independent study project that I will describe sometime during the semester.

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	March 9, 2015
Final Exam	May 8 - 14, 2015

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

Math Tutoring Center: Located in Cullimore, Room 214 (See: Spring 2015 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.

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Important Dates (See: Spring 2015 Academic Calendar, Registrar)

Date	Day	Event
January 20, 2015	T	First Day of Classes
Jnuary 26, 2015	M	End of Add/Drop Period

March 15 - 22, 2015	S - S	Spring Recess
March 30, 2015	M	Last Day to Withdraw
April 3, 2015	F	Good Friday - University Closed
May 5, 2015	T	Last Day of Classes
May 6 & 7, 2015	W & R	Reading Days
May 8 - 14, 2015	F - R	Final Exam Period

Course Outline

Week	Date	Section	Topic
1	1/21	1.1, 1.3	Overview / Discrete Biological Models / Difference Equations
2	1/26, 1/28	1.4, 1.6, 1.7, 1.8	Systems of Difference Equations / The Golden Mean / Complex Eigenvalues
3	2/2	1.9, 2.1, 2.2, 2.3	Applications / Nonlinear Difference Equations / Steady States and Stability / The Logistic Equation
	2/4		
4	2/9	2.5, 2.6, 2.7, 2.8, 2.9	Analysis of the Logistic Equation / Cobwebbing / Systems of Nonlinear Difference Equations / Steady States and Stability
	2/11		
5	2/16	2.10, 4.1	Examples / Continuous Models
	2/18		
6	2/23	4.2, 4.3, 4.4, 4.5	Bacterial Growth / Tumors / Dimensional Analysis
	2/25		
7	3/2	4.6, 4.7, 4.9, 4.10	Steady States and Stability / Stability in the Chemostat / Applications
	3/4		
8	3/9		**MIDTERM EXAM**
	3/11	5.1	Geometry of First Order ODEs
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9	3/23	5.2, 5.3, 5.4	Systems of 2 First Order ODEs / Geometric Analysis
	3/25		
10	3/30	5.5, 5.6, 5.7, 5.8	Nullclines / Phase Plane Diagrams / Geometric Analysis of Stability
	4/1		
11	4/6	5.10, 6.2,	Geometric Analysis of the Chemostat / The Predator-Prey System /

		7.1	Michaelis-Menten Kinetics
	4/8		
12	4/13	7.2, 7.3, 7.4	Sigmoidal Kinetics / Singular Perturbations
	4/15		
13	4/20	7.5, 7.7	Threshold-Governed Cellular Development / A Bimolecular Switch / Limit Cycles / Poincare-Bendixson Theory / Cubic Nullclines
	4/22		
14	4/27	8.6, 8.7	Hopf Bifurcation / Oscillations in Population Models
	4/29		
15	5/4	8.8	Oscillations in Chemical Models