Course Name: CALCULUS AND PROBABILITY FOR THE LIFE SCIENCES I

Course Number: MTH 227

Course Credits: 4

Terms offered: Winter, Spring

Meetings: Three 50-minute lectures and one 80-minute recitation weekly for 10 weeks.

Enforced Prerequisites: MTH 112 [C-] or MTH 150X [C-] or ALEKS math placement with a score of at least 75 or math placement test with a score of at least 33 or instructor permission.

Rationale for Prerequisites: Successful completion of either of these courses (or the given placement level) is required to ensure basic algebraic skills and adequate familiarity with the functions seen in this course. The initial review of exponential and trigonometric functions provided in the first week of this course assumes the previous exposure from the prerequisite course.

Catalog Description: Review of exponential and trigonometric functions, including examples of exponential and periodic behavior; discrete probability; examples of biologically motivated difference equations; differentiation of polynomials, exponential and trigonometric functions with applications to optimization. All courses used to satisfy MTH prerequisites must be completed with C- or better. PREREQS: MTH 112 [C-] or MTH 150X [C-] or Placement Test MPT(33) or Placement Test MPAL(075) and (MPT=Math Placement Test score of 33; MPAL=Math Placement Test-ALEKS score of 75%)

Course Content:

1. Discuss prototype problems that will be a theme for the rest of the course.

2. Review of exponential and trigonometric functions, including examples of exponential and periodic behavior.

3. Discrete probability, with applications to some of the motivating problems in topic #1.

4. Introduce examples of biologically-motivated difference equations.

5. Sequences and very basic asymptotic analysis.

6. Establish an intuition for instantaneous rate of change as a motivation for differentiation.

7. Rules for differentiation of polynomials, exponential, and trigonometric functions; Chain Rule.

Course schedule:
Week 1: Introduction: Examples of biological questions leading to mathematical problems
Week 2: Discrete probability of elementary events
Week 3: Discrete probability of compound events
Week 4: Conditional probability; Exam 1
Week 5: Sequences of real numbers and asymptotic analysis
Week 6: Difference equations
Week 7: Rates of change; Exam 2
Week 8: Derivatives of polynomials, exponential and trigonometric functions
Week 9: Rules for differentiation, including the Chain Rule
Week 10: Finding extrema of functions

Measurable Student Learning Outcomes: A successful student in MTH 227 will be able to:
1. Use the mathematical notions of sets and functions to represent biological data.
2. Use elements of probability to explain patterns in living systems.
3. Construct and interpret biologically-motivated sequences and linear difference equations.
4. Apply the concept of instantaneous rate of change to answer biological questions.
5. Write organized quantitative solutions to problems arising in the life sciences.

This course fulfills the Baccalaureate Core Mathematical Skills category. It does this by

1. **Identifying situations that can be modeled mathematically**: Modeling of exponentially growing populations such as cell populations which undergo cell division. Modeling of migrating populations. Modeling the success rate of several independently conducted experiments.

2. **Calculating and/or estimating the relevant variables and relations in a mathematical setting**. As far as its broad mathematical content, the course is divided into parts: Discrete probability and calculus. The techniques used in each part are much different from each other and also from the problem-solving strategies that the students have seen before. For discrete probability, students will need to familiarize themselves with, and apply the basic laws of probability. These require a solid understanding of the basic set operations of complement, intersection and union, and how the probabilities of these compound events are calculated. The main notion of calculus developed in this course are derivatives. These arise in the context of the rate of change of a variety of biological quantities that can be represented as functions of a real variable. A proper understanding of the derivative necessitates the development of limits, and their properties. Finally, sequences of real numbers, and their limiting behavior, are studied because they describe the dynamical behavior of several biological models that can be modeled by difference equations.
3. **Critiquing the applicability of a mathematical approach or the validity of a mathematical conclusion.** This course emphasizes mathematical techniques used by modern life scientists. Each mathematical topic is motivated by a biological problem with the purpose of training students to think more quantitatively.

**Evaluation of Student Performance:** Your grade and measurement of your progress on the course and Baccalaureate Core outcomes will be based on weekly online and written homework, quizzes and other classroom activities, along with two written midterms and a comprehensive final exam. Approximate percentages for each category are:

- Homework, quizzes and other in-class activities: 30%
- Two midterms: 20% each
- Comprehensive final exam: 30%

**In-class activities:** In each class, students work for five to ten minutes in groups and then present their work to the class. Clicker questions and worksheets are often used. These non-exam activities occur in an active-learning environment where the instructor and the class together interact with the material through a variety of modes. In recitation students use Excel and R for modeling, and the R-scripts are emailed to the instructor.

**Learning Resources:** The required textbook is *Mathematics for the Life Sciences* by Erin N. Bodine, Suzanne Lenhart and Louis J. Gross, Princeton University Press, 2014. Selected sections of chapters 4, 5, 10, 11, 12, 17, 18, 19 will be covered.

**Students with Disabilities:** Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

**Student Conduct:** All students are expected to adhere to OSU's Student Conduct Code at http://oregonstate.edu/studentconduct/ . Information on the consequences of Academic or Scholarly Dishonesty can be found at http://oregonstate.edu/studentconduct/offenses-0 .