MATH 152 - Spring 2016 - Syllabus

MATHEMATICS FOR THE LIFE SCIENCES

Time: 10:10 - 11:00 Monday and Wednesday, Small Section meetings Tuesdays at 11:10AM (Section 003), 12:40PM (Section 005)

Place: Humanities and Social Sciences 203. Small sections at 11:10AM will meet in Ayres 121, small section at 12:40PM will meet in Ayres 122.

Instructor: Dr. Louis Gross, Distinguished Professor of Ecology and Evolutionary Biology and Mathematics

Office: 401B Austin Peay. Office Hours: Monday 11-1 and Wednesday 11-12:15 and by appointment. The instructor will hold open evening electronic chat sessions up to twice a week, based upon demand. Phone: 974-4295 Email: gross@tiem.utk.edu

Teaching Assistant: Athmanathan Senthilnathan

All materials for the course, including assignments, will be posted on the Course web page (http://www.nimbios.org/~gross/math152.html). The UTK Blackboard site will only be used to post grades and to make announcements.

Course overview

This course provides an introduction to the use of continuous mathematics (Calculus) to analyze a variety of problems arising in the biological sciences. It is designed for students in biology, agriculture, forestry, wildlife, pre-medicine and other pre-health professions. Students who desire a strong mathematical grounding, enabling them to take most advanced math courses, should consider taking the sequence Math 141-2 instead. Math 151 is the presumed pre-requisite for this course, which is the second course in a two course sequence. Depending upon your curriculum, this sequence will partially satisfy graduation requirements for your major. The general aim of the sequence is to show how mathematical and analytical tools may be used to explore and explain a wide variety of biological phenomena that are not easily understood with verbal reasoning alone. Prerequisites are two years of high school algebra, a year of geometry, and half a year of trigonometry. If you have not previously taken Math151, please talk with the instructor.

This course includes a computational component and it is assumed that you have access to a computer on which the mathematical analysis software Matlab has been loaded. This software is also available on many of the computers on campus in the facilities managed by the **Office of Information Technology**. The software is available to you at no charge from the **OIT Software Distribution site**. There are many tutorials about Matlab, with some videos related to the use in this course posted on the course home page. A large number of tutorials are on the **Matlab Tutorial site**. No prior background in the use of Matlab is expected. The text for the course is:

Mathematics for the Life Sciences
by Erin Bodine, Suizanne Lenhart and Louis Gross. Supplemental material for the course is available on the **Text Home Page** which includes Matlab codes used in the text, a guide to R, and various notes from other instructors who use this text.

Course Goals:

- Develop your capability to be a quantitative scientist.
- Develop your ability to quantitatively analyze problems arising in the biological areas of interest to you.
- Illustrate the great utility of mathematical models to provide answers to key biological problems.
- Develop your appreciation of the use of the calculus to address problems in the life sciences.
- Provide experience using computer software to analyze data, investigate mathematical models and write your own computer programs.

Course Grading:

The grade will be based on several components: (a) There will be problems to turn in during class meetings on Mondays and Wednesdays based on discussions and group work that day, often derived from problems assigned from the text for that day; (b) There will be a set of assignments based on the use of the computer to analyze particular sets of data, or problems. These may be worked on within a study group, as long as it is clearly noted who participated, and each individual writes their own results; (c) There will be a set of three exams during the term, in addition to a comprehensive final. The exams will not be computer-based. They will focus on the key concepts and techniques discussed in the course. Of the three regular exams given, the one with the lowest score will be dropped. The final exam will be given Friday May 6 from 8:00-10:00 in the large class room (HSS203). The weighting of these components of the grade are: (a) 20%, (b) 20%, (c) 60% (the final exam counts 20% of the course grade, and the two regular exams not dropped will together count 40% of the grade).

Class Protocols:

The classroom mode for this course is "flipped" and we will be carrying out a variety of in-class activities designed to enhance your understanding of the course concepts and skills. Prior to each class, you are expected to have read the materials in the text for that day, and have worked on the assigned exercises from the text. These could be worked on individually or in study groups. In-class problem assignments will generally be based on these problems from the text. There will be regular small-group discussions in class and you will be expected to hand in (or send by email) a written response from these exercises that will count towards your course grade. Thus attendance is expected in each class. Questions about problems from the text may be addressed during the small class sessions on Tuesdays, by attending the office hours of the teaching assistant or the instructor, or through the electronic chats the instructor will hold. Opportunities for extra credit may be made available as the course proceeds, for those desiring this. These may be additional computer-based laboratory projects or videos you produce related to course topics.

In-class use of technology (e.g. laptops, tablets, cell phones, etc.) is allowed and encouraged as long as it relates to the topics of the course. It is expected however that your use of these devices will not be distracting to others in the class, but rather to enhance your discussions about course material with other students. At all times your attention during class periods is expected to be focused on the course. The instructor will indicate times during which electronic devices are to be closed. In-class tests will be conducted without access to any electronic devices. These tests are designed so as not to require any devices but if you feel that having a simple calculator available will ease your comfort level, then you may use one (this means a separate simple calculator, not one on a cell phone or other device such as a tablet).

If you would like to refresh your background in the prerequisites for this course you may find the **Khan Academy Math Tutorials** helpful. The Math Department also offers a free **Tutorial Center** that is staffed by students who are able to answer questions about the prerequisite topics for this course.

Any student who feels s/he may need an accommodation based on the impact of a disability should contact the instructor privately to discuss your specific needs. The **Office of Disability Services** can assist in coordinating reasonable accommodations for students with documented disabilities.

Course Outline:

The pace of the material covered will be adjusted as necessary, but the approximate time to be spent on various topics over the semester and the dates of coverage are given below.

• Limits and Continuity (Unit 4 – Chapters 15-16 in the text) – limits of functions, properties of limits, continuity, Intermediate Value Theorem - January 13 - 20
• Rates of Change (Chapter 17) – average rate of change, estimating rate of change, velocity, photosynthesis and other examples – January 27 – February 8

• Exam 1 (Chapters 15-17 of the Text) – February 9

• Derivatives - (Chapter 18 -19) – Definition of a derivative, derivative of exponential, trigonometric and logarithm functions, computing derivatives, product rule, chain rule- February 10 - 17
• Maxima and Minima - (Chapter 20) – First and second derivative tests, Mean Value Theorem, concavity, optimization problems – February 22 - 29

• Exam 2 (Chapters 18-20 of the text) – March 1

• Areas and Antiderivatives (Chapters 21-22) – estimating areas under curves, definition of antiderivative, definition of integral, Fundamental Theorem of Calculus, average values of functions – March 2 – 21

• Integration and Applications (Chapter 23-24) – methods of integration, substitution, integration by parts, areas, volumes, density functions – March 22 – April 4

• Exam 3 (Chapters 21-24) – April 5

• Continuous Probability (Chapter 25) –expected value, normal distribution, waiting times – April 6-12

• Differential Equations (Chapter 26) – solutions, separation of variables– April 13-19

• Equilibria (Chapter 26) – limited population growth, logistic growth, equilibria, stability– April 20-25

• Review – April 26-27

• Final Exam (Comprehensive - all topics covered) – May 6 - 8:00Am- 10:00 AM in HSS 203