MATH 103 (3) Integral Calculus with Applications to Life Sciences. Antiderivatives, the definite integral, integration techniques, numerical integration, infinite series, applications of integration to differential equations and probability, linear algebra. Credit will be granted for only one of MATH 101, MATH 103, or MATH 142. [3-1-0] Prerequisite: One of MATH 100, MATH 116.

Course Overview: The proposed course will focus predominantly on single variable integration and its applications. While the list of topics aligns well with a general calculus course, most of the concepts will be presented through applications in life sciences including applications in Biology. The course will start off with integration. In this first chapter we will learn how to integrate using the substitution rule, find the area between two curves, and use integration to calculate cumulative rates of change and average values. In the second chapter, we will learn how to integrate using integration by parts, integrate by using partial fractions, find improper integrals, and integrate numerically. In the third chapter, we will learn how to use integrals to solve separable differential equations and describe the behavior of solutions. In the fourth chapter, we will learn how to solve system of linear equations (2 equations and 2 unknowns), perform algebraic operations on 2 x 2 matrices, and find the eigenvalues and eigenvectors of 2 x 2 matrices. In chapter 5, we will learn how to calculate the sum of a geometric series, determine whether a given series is convergent or divergent by using the appropriate test(s), and find the Taylor series of a function. In the last chapter, we will learn how to calculate probabilities for continuous random variables, find the expected value, variance, and standard deviation of a continuous random variable, and find the linear regression line.

Contents: Topics include Integration: antiderivatives and indefinite integrals, area and the definite integral, the fundamental theorem of calculus, applications of integration (areas, net change, average values). Techniques of Integration and Computational Methods: integration by parts, integration using partial fractions, improper integrals, numerical integration (the midpoint rule and the trapezoidal rule). Senate form version: October, 2019 Differential Equations: solving first order separable differential equations, equilibria and their stability (compartment models, the Levins model, the Allee effect). Linear Algebra: systems of linear equations, matrix operations, eigenvectors and eigenvalues, an application: the Leslie matrix. (We restrict ourselves to 2 x 2 matrices.) Infinite Series: series (geometric series), Taylor series. Continuous Probability Distributions and Linear Regression: density functions, special probability density functions, linear regression.

Course Objectives: To acquire a working knowledge of a broad range of mathematical concepts which are foundational to biology and data analysis in biology. Specific objectives - to understand the essential calculus concepts and techniques at the same level as for the general calculus course. - to gain some exposure to more advanced calculus concepts from a computational viewpoint as opposed to a full mathematically rigorous treatment. - to appreciate the connection between biological phenomena and mathematical models by using linear algebra and differential equations. - to understand some basic statistical methods to understand a set of data.

Learning Outcomes After completing this course, students will be able to: Understand the basic idea of integral calculus: finding the area under a curve. Approximate the area under a curve by using the left, right, or midpoint Riemann sums. Evaluate integrals by using basic antiderivative formulas. Evaluate integrals by using techniques such as substitution, integration by parts, and partial fraction decomposition. Use integrals to find the area between two curves, the cumulative/net change, and the average value of a function. Approximate the value of a definite integral using the midpoint rule and the trapezoidal rule. Determine whether an improper integral converges or diverges, and evaluate it if it is convergent. Solve and analyze first-order separable differential equations. Specifically, students should be able to: - Use integrals to solve separable differential equations; - Find equilibria and determine their stability graphically and analytically; - Describe the behavior of solutions of differential equations starting from different initial conditions. - Construct a differential equation modelling a quantity described in a problem. Compute the eigenvalues and eigenvectors of 2 x 2 matrices, and apply this to the study of Leslie matrices, which are used extensively in ecology to model the changes in population of organisms over a period of time. Find the sum of a geometric series or determine that a geometric series is divergent. Find the Taylor (or Maclaurin) series of a function. Senate form version: October, 2019 Calculate probabilities for continuous variables, find the expected values and the standard deviation, and find the linear regression line.