Spring 2022

Syllabus — Math 215
Applied Calculus I (4 credits)

Course Description: Basic concepts; differentiation, differential equations and integration with applications directed primarily to the life sciences. Credit allowed for at most one of 203, 215, 241, 251A. Pre: 140 or assessment (placement) exam.

Possible Texts:

- *Biocalculus: Calculus, Probability, and Statistics for the Life Sciences* by James Stewart and Troy Day. Cengage Learning.
- *Calculus for the Life Sciences* by Greenwell, Ritchey and Lial. Addison Wesley.
- *Calculus for Biology and Medicine* by C. Newhauser. Prentice Hall.

Format: This four credit class meets for 150 minutes of lecture and 100 minutes of recitation per week.

Course outline

0. (Re)introduction to function theory (1 week)

A. We review polynomial (especially linear) functions, logarithms, exponentials and to some extent trigonometric functions. Special attention will be paid to the graphs of these functions.

B. The concepts of composition of functions and inverses function are also considered again.

C. New topics introduced here may include boundedness, continuity, limits at infinity, monotonicity, local and absolute extremes and concavity of functions.

1. Differentiation (8 weeks)

A. We define and give several interpretations to the idea of differentiation. Differentials are used to approximate the change in the value of a function.

B. The derivative of most of the functions considered in Section 0 are introduced. Some of these derivatives will be computed using the definition; others will simply be given and these formulas will be supported by computer experimentation. If subsequently a more rigorous justification of any of these latter formulas is possible then it will be given.

C. The standard rules for differentiating sums, products, quotients and composition of functions are presented. The chain rule is used to obtain the derivative to the inverse of a differentiable function.

D. The Mean Value Theorem is presented and used. In particular, we will show that antiderivates are determined up to an additive constant.

E. Applications of differentiation are considered. In particular, properties of the graphs of functions and optimization are studied.

2. Integration (5 weeks)

A. We define and give several interpretations to the idea of integration. Numerical methods of integration are considered.

B. The Fundamental Theorem is presented and used.

C. The standard integration rules are studied, in particular, substitution and integration by parts.

D. Applications of integration are introduced: area, average, volumes of solids of revolution.

E. Improper integrals are defined and computed.

3. Differential Equations (1.5 weeks)

A. The study of differential equations is begun: solve separable and first order linear differential equations. Important examples are exponential growth and decay and the logistic differential equation. Optional: Euler's method can be introduced and used as the basis for numerical studies.

Course Objectives and Student Learning Outcomes. Upon successful completion of Math 215, the student will be able to solve routine problems of differential and integral calculus and their applications to the life sciences. They will be able to apply ideas of calculus and differential equations to the understanding of some biological processes.

Program Objectives. In this introductory level course students learn the basics about differentiation and integration of functions, and use and solution of differential equations. The approach emphasizes computation and application over theory. The course material is fundamental for life science majors. The course is the first in a two semester sequence.