# Course Syllabus

# NUMERICAL ANALYSIS (MATH 370/570)

**Description:** *Analysis and implementation of numerical techniques such as root finding, polynomial interpolation, the finite difference method, quadrature methods, and numerical solutions to differential equations, with an emphasis on theory and error analysis.*

**Credit Hours:** 3

**Frequency:** Usually offered in the spring semester of even-numbered years.

**Audience:** Elective for math and engineering majors, and for the analytics and modeling master's program.

**Prerequisites:** Math 264 or Math 270. Previous computer programming or spreadsheet experience is recommended but not required.

**Format:** 2 lectures (75 min) per week

**Textbook:** *Numerical Analysis (10th ed.)*, by Richard L. Burden and J. Douglas Faires. (Required)
ISBN-10: 1305253663

**Software:** Use of either *Maple* or *MATLAB* is required, determined by the instructor (both applications are available on campus computers; purchase of student version is recommended).

**Internet:** Course material and grades are often maintained in Blackboard, at the discretion of the instructor.

**Access & Accommodations:** The Access & Accommodations Resource Center (AARC) is the campus office that works with students to provide access and accommodations in cases of diagnosed mental or emotional health issues, attentional or learning disabilities, vision or hearing limitations, chronic diseases, or allergies. You can contact the office at aarc@valpo.edu or 219.464.5206. Students who need, or think they may need, accommodations due to a diagnosis, or who think they have a diagnosis, are invited to contact AARC to arrange a confidential discussion with the AARC office. Further, students who are registered with AARC are required to contact their professor(s) if they wish to exercise the accommodations outlined in their letter from the AARC.

**Notice of Cancellation:** In the event class is cancelled, you will be notified through your Valparaiso University e-mail account.

## Course Goals

A. Students understand fundamental concepts of numerical analysis.
B. Students can follow general algorithms to solve numerical problems beyond the techniques learned in calculus.
C. Students can compute solutions to problems using technology (e.g. a computer).

D. Students will apply their problem solving skills to multiple disciplines which rely on approximation, such as engineering, physics, chemistry, biology, etc.
E. Students will cooperate *when appropriate* (see section syllabus for details) to help each other understand the concepts of numerical analysis and to learn how to function in a work group

**Topical Objectives**. Preface: *Students will be able to …*

1. understand how a computer performs arithmetic
2. anticipate how round-off error can affect computer calculations
3. determine the rate of convergence of an algorithm
4. solve an equation in one variable numerically using a number of algorithms including (but not limited to) the Bisection Method, fixed point iteration and Newton's Method
5. approximate the value of a function at a given point using a Lagrange interpolating polynomial
6. approximate the value of a function at a given point using cubic spline interpolation
7. approximate the derivative of a function numerically
8. approximate a definite integral using a number of quadrature techniques
9. approximate solutions to initial-value problems for ordinary differential equations using a number of algorithms including (but not limited to) Euler's Method and the Runge-Kutta Method
10. perform a selection of other numerical techniques at the discretion of the instructor

**General Objectives** (with goals addressed). Preface: *Students will be able to …*

11. identify when certain theorems apply, and if not, identify what hypothesis is violated (A)
12. carry over and apply knowledge from Calculus and Linear Algebra such as Newton's Method, Riemann Sums and matrix operations (A,B)
13. use computer software packages to approximate solutions to multiple types of mathematical problems (C,E)
14. check results (produced both manually and with technology) and recognize those which are obviously false (A,B,C,D,E)
15. write clear and detailed solutions to assigned problems in both mathematical jargon and the jargon of the field of application (D,E)