ROWAN UNIVERSITY
Department of Mathematics

Syllabus
MATH 01.332 - Introduction to Numerical Analysis

CATALOG DESCRIPTION:

MATH 01.332 Numerical Analysis, 3 s.h.
Prerequisites: CS 01.104 (Introduction to Scientific Programming), MATH 01.131 (Calculus II), and MATH 01.210 (Linear Algebra) with a C- or better in all the three courses

This course includes: elements of error analysis, root finding methods, interpolation, cubic splines, numerical integration and differentiation schemes, least square methods, numerical solutions of ordinary differential equations (initial value and boundary value problems), and numerical techniques to solve systems of equations. The students are expected to write codes in addition to using graphing calculators.

OBJECTIVES:

The purpose of numerical analysis is two-fold: (1) to find acceptable approximate solutions when exact solutions are either impossible or too arduous and time-consuming to be practical, and (2) to devise alternate methods of solution better suited to the capabilities of computers.

While the students will be engaged considerably in computation in order to obtain acceptable results for an assignment, the underlying theory will be equally emphasized. In addition to programming skills, the success in this course depends on sufficient knowledge in calculus, linear algebra, and other branches of mathematics, e.g. differential equations.

CONTENT:

1. Errors in Computation

2. Finding Roots of Equations by Approximation
   2.1 Graphical and other rough methods
   2.2 Methods of refinement, false position, iteration
   2.3 Newton-Raphson method

3. Finite Differences and Polynomial Approximations
   3.1 Finite differences, definition and theorems
   3.2 Approximating polynomials, Gregory-Newton formula
   3.3 Interpolation and extrapolation of tables
   3.4 Error Analysis

4. Finite Integration
   4.1 Finite integrals, definition and theorems
   4.2 Summation of series
   4.3 Quadrature formulas, Trapezoidal, Simpson, Weddle rules.
   4.4 Richardson Extrapolation and Romberg Integration

5. Solutions of Systems of Equations
    5.1 Scaled Gaussian Elimination
    5.2 The Gauss-Seidel and Jacobi Iterative Methods

6. Additional topics, as time permits, from
    6.1 Approximation by Least Square Method
    6.2 Numerical Solution of Differential Equations
    6.3 Fractal and Chaos

TEXTS: The following might be possible texts for this course:

Burden, R.L. and Faires, D.F., <u>Numerical Analysis</u>, 5th ed. PWS-Kent, Boston, MA.

Cheney, Ward and Kincaid, David, <u>Numerical Analysis and Computing</u>, 6th ed., Brooks/Cole, Pacific Grove, CA.

Marion, M.J., <u>Numerical Analysis, A Practical Approach</u>, Macmillian, New York, NY.

Atkinson, K., Han, W., <u>Elementary Numerical Analysis,</u> 3rd ed., Wiley.