Catalogue Description

Error analysis, finite differences, integrative methods, interpolation, and numerical differentiation and integration are the topics studied in this class. 3 credits  Prerequisites: MATH 290 Calculus III or equivalent

Goals

A. To strengthen the student's grasp of basic notions in analysis and algebra, e.g. the idea of a sequence, limit, recursion relation, definite integral, matrix techniques in algebra.
B. To help the student see the connection between an algorithm as a computational procedure and the mathematical foundations.
C. To help the student appreciate the type of algorithmic approach that enables a problem to be handled by a computer.
D. To understand the nature of a recursive formula with specific examples used to solve certain classes of problems.
E. To see how a computational procedure is developed from the mathematical theory.
F. To learn basic principles of computation as an art in so far as it pertains to matters of precision, accuracy, errors, and checking, by carrying out actual numerical calculations with specific problems.
G. To learn the basic techniques used to approximate a given function by simpler functions.
H. To understand the basic theorems concerned with convergence of sequences generated by iterative procedures.

Procedures

A. Lectures covering theory and areas of application.
B. Verification of algorithms using computing facilities.
C. Assignment of problems.

Course Content

A. Solution of Equations (10 Lessons)
   1. Functional iteration
   2. Convergence Theorems including Cauchy Criterion
   3. Lipschitz condition
   4. Aitken's delta-squared method
   5. Newton-Raphson method
   6. Method of false position
   7. Method of chords
   8. Bisection method
   9. Bairstow's method for polynomial equations
   10. Von Mise's method

B. Polynomial Approximation (15 Lessons)
   1. Evaluation of polynomials
   2. Taylor polynomial
3. Legendre polynomial
4. Least-squares approximation
5. Definitions of norms
6. Error of approximation
7. Lagrange's interpolation formula
8. Gram-Schmidt process
9. Chebyshev polynomials
10. Trigonometric approximations
11. Newton's interpolation polynomial with divided differences
12. Ordinary differences. Forward and backward difference operator
13. Trapezoidal rule
14. Simpson's rule
15. Gaussian quadrature

C. Solution of Ordinary Differential Equations (5 Lessons)
   1. Numerical differentiation
   2. Runge-Kutta with Runge's coefficients
   3. Adams-Moulton Predictor-Corrector method

D. Matrix Algebra and Simultaneous Equations (10 Lessons)
   1. Elementary operations
   2. Gauss-Jordan elimination method
   3. Matrix inversion
   4. Gauss-Seidel iterative method
   5. Eigenvalues and Eigenvectors

E. Monte Carlo (5 Lessons)
   1. Random number generators
   2. Solution of problems
   3. Statistical analysis

Evaluation methods
   1. Final examination, periodic quizzes.
   2. Class Participation
   3. Assignment of specific problems to be turned in.
   4. Writing of programs to be tested on the computer.

Bibliography


