Jimma University
College of Natural Sciences
Department Of Mathematics

Course title: Numerical Analysis II
Course Code: Math 440
Credit hours: 3 Contact hrs: 3
Prerequisite: Math 343
Corequisite: Math 481
Course category: Elective

Aims

This course aims at introducing numerical method for solving mathematical problems
that cannot be solved analytically. It is a cross road of several discipline of mathematics that have great relevance in modern applied sciences.

Course Descriptions

The course deals with a review of interpolation and numerical integration, approximation theory, numerical methods for initial value and boundary value
problems and methods for solving eigenvalue problems.

Course objectives

On completion of the course, successful students will be able to:

- use numerical methods for approximating functions,
- derive numerical methods for solving initial and boundary value problems,
- investigate the stability and convergence properties of numerical methods,
- identify the numerical methods that preserve the quantitative behaviour of solution,
- solve eigenvalue problems,
- translate complex algorithms into computer programming format.

Course outline

Chapter 1: Revision of numerical integration

1.1 Interpolation
1.2 Trapezoidal and Simpson's rules, Gaussian quadrature
1.3 Multiple integration

Chapter 2: Approximation theory

2.1 Least-square approximation
2.2 Approximation of functions by orthogonal polynomials (such as Chebyshev, Legendre and Fourier series)

Chapter 3: Numerical methods for ordinary differential equations

3.1 The initial value problem

3.1.1 Taylor's method of order n
3.1.2 Euler's methods
3.1.3 Runge-Kutta methods
3.1.4 Multistep methods
3.1.5 Higher-order equations and system

3.2 Boundary value problems

3.2.1 The Linear shooting method
3.2.2 The Shooting method for nonlinear problems
3.2.3 Finite Difference method for linear problems
3.2.4 Finite-Difference method for nonlinear problems

Chapter 4: Eigenvalue problems

4.1 Basic properties of eigen values and eigen vectors
4.2 The power method for finding dominant eigen values
4.3 Householder's method and the QR algorithm

Teaching- learning methods

Three contact hours of lectures and two hours of computer lab per week.

Students do
home assignment.

Assessment methods

Computer lab assignment	20%
Mid semester examination	30%
Final examination	50%

Teaching Materials

Textbook:
- Gerald C. F. and Wheatlly P. O., Applied numerical analysis 5th ed, Edsion Wesley,Co

References:
- P.A. Strock, Richard L. Burden, Numerical Analysis- - Volkov, Numerical methods 1986
- Frank Ayres, Theory and Differential Equations Schuam's outline series, 1981
- Robert Ellis and Denny Glick, Calculus with Analytical Geometry, 3rd Ed.
- Murry R. Advanced Calculus, Spiegel Advanced Calculus for Engineering and Scientists- Murry R. Spiegel