Addis Ababa University
A.A. Institute of Technology
School of Electrical & Computer Engineering

Analytical & Computational Methods in Engineering ECEG-6201

Course Outline

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Chapter 1: Complex Variables

Introduction; Complex numbers; Functions of a complex variable; Power series; Some elementary functions; Conformal transformations; Singularities and Zeros; Complex integrals; Cauchy's theorem; Cauchy's integral formulas; Taylor and Laurent series; Residue theorem; Residue integration of real integrals.

Chapter 2: Ordinary Differential Equations

Introduction; First Order LDE: Separable ODE, Homogeneous ODE, Exact ODE, Linear first order equations; Second Order DE; Series solutions of ordinary differential equations:- Series solutions about an ordinary point, Series solutions about a regular singular point; Numerical Solutions of ODE:- Euler's method, Improved Euler method, The Runge-Kutta method, Milnes method; Special functions:- The gamma and beta functions, Legendre functions, Bessel's functions, Hypergeometric functions.

Chapter 3: Partial Differential Equations

Linear PDEs of the first order; Second-order equations; Separation of variables method.

Chapter 4: Finite Difference Methods

Introduction; Finite difference schemes; Finite differencing of Parabolic PDEs: Explicit and implicit methods; Finite differencing of hyperbolic PDEs; Finite differencing of elliptic PDEs.

Chapter 5: Finite Element Methods

Introduction; Solutions of Laplace's Equations: FE discretization, Element governing equations, Assembling and solving; Solutions of Poisson's equation; Solution of the wave equation.

References

1. C.R. Wylie, *Advanced Engineering Mathematics*.
2. K.F. Riley, M.P. Hobson and S. J. Bence, *Mathematical Methods for Physics and Engineering*.
3. Matthew N.O. Sadiku, *Numerical Methods in Electromagnetics*, 2nd ed, CRC Press 2001.
4. G.D. Smith, *Numerical Solution of Partial Differential Equations: Finite Difference Methods*, 3rd ed., Oxford University Press, NY, 1985.
5. J.H. Ferziger, *Numerical Methods for Engineering Applications*, John Wiley, NY, 1981.
6. Mohammad Abdo, *Introduction to Computational Methods*.