Addis Ababa University
Addis Ababa institute of Technology
School of Mechanical and Industrial Engineering

Numerical Methods Course Outline

Numerical Methods [Meng 2073]

Semester: II Credit Hrs: 3

1. **MATHEMATICAL MODELLING**
   - **1.1 Introduction**
   - **1.2 Mathematical Models**
   - **1.3 Model evaluation**
2. **ROOTS OF EQUATIONS**
   - **2.1 Introduction**
   - **2.2 Graphical method**
   - **2.3 The Bisection method**
   - **2.4 The False position (Regula- Falsi method)**
   - **2.5 Fixed Point Iteration**
   - **2.6 Newton-Raphson Method**
   - **2.7 Secant Method**
3. **LINEAR ALGEBRAIC EQUATIONS**
   - **3.1 Introduction**
   - **3.2 Non - Computer methods**
     - The Graphical Method
     - Cramer's Rule
     - Elimination of Unknowns
   - **3.3 Gauss Elimination**
     - Description of the method
     - Pitfalls of Gauss Elimination
     - Techniques for Improving Solutions
     - Gauss-Jordan Elimination
   - **3.4 LU-Decomposition**
   - **3.5 Gauss-Seidel Method**
4. **CURVE FITTING**
   - **4.1 Introduction**
   - **4.2 Least squares regression**
     - Linear regression
     - Polynomial regression
     - Multiple linear regressions
     - General linear least squares
   - **4.3 Interpolation**

Newton's Divided Difference Interpolating Polynomials

General form of Newton's Interpolating Polynomials

Lagrange Interpolation Polynomials

Spline Interpolation

5. **NUMERICAL DIFFERENTIATION & INTEGRATION**
   - **5.1 Introduction**
   - **5.2 Numerical differentiation**
     - Lower Order Methods
     - High-Accuracy Differentiation Formulas
   - **5.3 Newton-Cotes integration formulas**
     - The Trapezoidal Rule
     - Simpson's Rules
6. **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**
   - **6.1 Introduction**
   - **6.2 Euler's Method**
   - **6.3 Runge-Kutta Method**

Evaluation:

Assignment: ---------- 10%

Lab Test ----------10%

Quiz: ---------- 10%

Project ----------10%

IM Exam: ---------- 20%

Final Exam: ---------- 40%

Note: The Student is expected to fulfill 85% of the attendance in lecture classes and 100% during lab.

References:

- **Steven C. Chapra: Numerical Methods for Engineers-VI edition, McGraw-Hill Publishing.**
- **R.W. Hamming: Numerical Methods for Scientists and Engineers.**