

Numerical Methods

Course Name: Numerical Methods

Course Code: GEN207

Credit hours: 3

Knowledge Domain: General fundamentals.

Prerequisite(s): Mathematics (2) (GEN104)

Learning Objectives

Upon completion of this course, the student will be able to:

1. Grasp the basic elements of numerical methods and error analysis.
2. Understand the basics of approximation, integration and differentiation.
3. Apply the numerical solution of differential equation.
4. Solve linear & nonlinear algebraic equation.

Learning Outcomes

1. Grasping the basic elements of numerical methods with application to approximation, integration, differentiation, differential equations and algebraic equations.
2. Training on using some software packages.

Overview and Syllabus

Mathematical preliminaries and error analysis. Solutions of equations of one variable. Interpolation and polynomial approximation. Numerical integration and differentiation. Numerical solution of initial value problems. Direct methods for solving linear systems. Solutions of systems of nonlinear equations.

Course Outline

	Topic
1	<u>Module 01: Errors</u> Introduction Objectives Lesson 01: Introductory Lesson Lesson 02 : Rounding Off Errors Lesson 03 : Truncation Error Lesson 04 : Absolute, Relative and Percentage Errors

	<p>Lesson 05 : The Maximum Error for a Function of Multi Variables Summary Assessment</p>
2	<p><u>Module 02: Numerical Solutions of Nonlinear Equations</u> Introduction Objectives Lesson 01: Introductory Lesson Lesson 02 : Simple Iteration Method Lesson 03 : Newton's Raphson Method Lesson 04 : Bisection Method Summary Assessment</p>
3	<p><u>Module 03: Numerical Solutions of Linear System of Equations</u> Introduction Objectives Lesson 01: Introductory Lesson Lesson 02 : Direct Methods Lesson 03 : Indirect Methods Lesson 04 : Sensitive Linear Systems Summary Assessment</p>
4	<p><u>Module 04: Interpolation Techniques</u> Introduction Objectives Lesson 01: Introductory Lesson Lesson 02 : Lagrange Method Lesson 03 : Newton Forward Method Lesson 04 : Newton backward Method Summary Assessment</p>
5	<p><u>Module 05: Numerical Differentiation and Integration</u> Introduction Objectives Lesson 01: Introductory Lesson Lesson 02 : Numerical Differentiation Lesson 03 : Numerical Integration Summary Assessment</p>
6	<p><u>Module 06: Curve Fitting</u> Introduction</p>

	<p>Objectives</p> <p>Lesson 01: Introductory Lesson</p> <p>Lesson 02 : Least Squares Error Measure</p> <p>Lesson 03 : The Use of the Bases</p> <p>Lesson 04 : The Use of The Legendre Polynomials Bases</p> <p>Summary</p> <p>Assessment</p>
7	<p><u>Module 07: Numerical Solutions of Differential Equations</u></p> <p>Introduction</p> <p>Objectives</p> <p>Lesson 01: Introductory Lesson</p> <p>Lesson 02 : Euler Method</p> <p>Lesson 03 : Taylor Series Method</p> <p>Lesson 04 : Runge Kutta Methods</p> <p>Summary</p> <p>Assessment</p>
8	<p><u>Module 08: Solutions of a System of Non Linear Equations</u></p> <p>Introduction</p> <p>Objectives</p> <p>Lesson 01: Introductory Lesson</p> <p>Lesson 02 : Newton Method</p> <p>Lesson 03 : Iteration Method</p> <p>Lesson 04 : Steepest Descent Method (Gradient Method)</p> <p>Summary</p> <p>Assessment</p>