BECM 2213

# Numerical Analysis and Computer Programming

## Introduction to Numerical Analysis

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# Syllabus (Numerical Analysis)

- **Solution of Algebraic & Transcendental Equations:** Bisection method, Regular falsi method, Newton-Raphson method, Iteration method, Rate of convergence, Order of errors.
- **Interpolation:** Simple differences, difference table, differences of a polynomial,newton's formula for interpolation, central difference for interpolation formula, divided differences,tables of divided differences, Newton's general interpolation formula,Lagrange's interpolation formula, inverse interpolation by lagrange's formula and successive approximation.

# Syllabus (Numerical Analysis)

- **Solution of system of linear equations:** Matrices, Gaussian elimination method, gaussian elimination method, Gauss-seidal iteration method
- **Numerical differentiation and intregation,**
- **Curve fitting by least squares**
- **Solution of differential equations:** Picard's method, Euler's method and Runge-Kutta method.

# Learning Outcomes

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.
- Write efficient, well-documented Matlab code and present numerical results in an informative way.

# References


- Numerical Mathematical Analysis – James.B. Scarborough
- Introductory Methods of Numerical Analysis – S.S. Sastry
- Numerical Methods for Engineers – S.C. Chapra and R.P. Canale

## Introduction:

Numerical analysis is the study of approximation techniques for solving the mathematical problems, taking into account the extent of possible errors.

Numerical analysis is the study, development and analysis for obtaining numerical solutions to various mathematical problems. It is also called mathematics of scientific computing.

# Application

- Building models based on data, be it through interpolation, Least Square, or other methods
- Estimating the solution to a set of linear and nonlinear equations
- Computational geometry
- Finite Element Analysis ( Structural analysis)
- Computational Fluid Dynamics ( Flows in Spillways, canals etc)
- Pollutant dispersal (Statistical analysis)
- Artificial Neural Networks (Hydrological Forecasting)
- Systems Approach (Inventory management and queuing systems often found on construction sites)
- Transportation models
- Weather forecasting and climatic models
- Geotechnical slope analysis

## Limitation Of Bisection Method

1. The conditions f(a), f(b) < 0, for locating roots may not be valid for certain equations.
2. The convergence of bisection method is slow.
3. Need good initial approximation to guarantee convergence.
4. Too much computation in order to obtain a root of the desired degree of accuracy.

## Limitation Of Regula-Falsi Method

1. Slow process.
2. We considered the graphical representation of the f(x) is always a curve but it is not always so.

## Limitation Of Newton Raphson Method

1. It require the derivatives of f(x), if complicated then this method will tend to fail.

2. It require very accurate initial value or intial guess Xo. Must be near the root you need to approximate.

3. Function and its derivatives should be continuous on the range you search for root in it. If it was not, so convergence of this method is a dream.

## Self Study

Limitations of Iteration method.

Convergence of NRM and IM method.

Comparisons between all methods.

Advantages of NRM and IM over RFM and BSM.

# THANK YOU