Version No:
Approval Date:

Numerical Analysis

Programme(s) in which it is offered: B.Sc.B.Ed. Mathematics

Course Category: Elective	**Schedule of Offering**: Odd
Course Credit Structure: 3	**Course Code:** EG451
Total Number of Hours: 4	**Contact Hours Per Week:** 4
Lecture: 2, 2	**Tutorial:** 1, 2
Practical: 0, 0	**Medium of Instruction:** English
Date of Revision:	**Skill Focus:** Employability
Short Name of the Course: Numerical Analysis	**Course Stream:**
Grading Method: Regular	**Repeatable:** Credit
Course Level: Beginner	

Course Description

This course is an elective course for B.Sc. B.Ed. Mathematics students. This course is a first course in Numerical analysis, the study of methods that use numerical approximation for the problems of mathematical analysis. Numerical analysis naturally finds application in all fields of engineering and the physical sciences, and also in the life sciences, social sciences, medicine and business.

Course Introduction

This course is an introductory course in Numerical Analysis – the study of methods that use numerical approximation for the problems of mathematical analysis. The course discusses the theory and application of numerical approximation techniques. It covers the solution of nonlinear equations, system of simultaneous linear equations, interpolation and approximation, Finite differences, numerical integration and differentiation.

Course Objective

The objectives of the course are:

1. To familiarise the students with the concepts and techniques in Numerical Analysis
2. To sensitise the students on the applications of Numerical Methods to solve different kinds of equations
3. To familiarise the students with the concept and applications of interpolation

4. To equip the students with the tools of numerical differentiation and integration

Course Outcome

At the end of the course students will be able to

1. Apply appropriate numerical methods to solve algebraic, transcendental and differential equations
2. Solve a system of simultaneous linear equations using direct and iteration methods
3. Deduce the interpolating polynomials of appropriate kind and apply them in interpolating a given data
4. Apply the methods of numerical differentiation in finding derivatives up to second order
5. Apply the methods of numerical integration in solving problems
6. Appreciate the applications and significance of numerical methods in solving problems from the fields of astronomy, physics, medicine etc.

PO-CO Mapping

<This should explain how the Course Outcomes (CO) are mapped with the Programme Outcomes (PO). All programmes to have two generic POs which can map to all minors/proficiency courses and foundation/self-immersion courses. Please tick the respective cells only; leave the other cells blank.>

PO-CO Mapping Matrix

CO/PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

Prerequisites and other constraints

This course is offered to all students of B.Sc.B.Ed. Mathematics. There is no prerequisite course.

Pedagogy

The teaching-learning of the course is organized through lectures, problem-solving sessions and student presentations.

Suggested Reading:

1. Saxena (2010). Finite Difference and Numerical Analysis. S Chand and Co. Ltd.
2. Sastry (2012). Introductory Methods of Numerical Analysis. PHI.
3. Grewal (2013). Numerical Methods for Scientists and Engineers. Khanna Publishers.
4. Grewal (1965). Higher Engineering Mathematics. Khanna Publishers.
5. Kreyszig (2015). Advanced Engineering Mathematics. Wiley Eastern Ltd.
6. Milne (2016). Numerical Calculus. Princeton University Press.
7. Hildebrand (2003). Introduction to Numerical Analysis. Dover Publications Inc.
8. Scheid (1988). Numerical Analysis - Schaum's Outline Series. McGraw-Hill Education.

Evaluation Pattern

Evaluation Matrix

	Component Type	Weightage Percentage	Total Marks	Tentative Dates	Course Outcome Mapping
Continuous Internal Assessment (CIA) Components*	Mid-semester exam	50% of CIA	30	Around 9th week	1, 2, 6
	Assignment	25% of CIA	15	End of each module	1, 2, 3, 4, 5, 6
	Quizzes	17% of CIA	10	Every two weeks	1, 2, 3, 4, 5, 6
	Presentations	8% of CIA	5	End of two modules	1, 2, 3, 4, 5, 6
	CIA Marks	**100% of CIA**	**60**		
ESE		40%	**80**	End of the semester	1, 2, 3, 4, 5, 6

Module Sessions

Module 1: Numerical Methods to Solve Equations (15 hours)

Algebraic and Transcendental equations: Bisection Method, Method of false position, Iteration method, Newton-Raphson method, Secant Method. First order linear

differential equations: Euler-Cauchy method, Modified Euler's method, Runge-Kutta fourth order method, Picard's method.

Reading:

1. Saxena
2. Sastry
3. Grewal (2013)

Activities:

a. Quiz
b. Assignment

Module 2: Solution to system of simultaneous linear equations (10 Hours)

Consistency and inconsistency of systems; Well-defined and ill-defined systems. Direct methods of solution: Gauss elimination method, LU factorisation, Matrix inversion and Cartan's method. Iteration methods: Gauss-Siedel method, Gauss-Jacobi method etc. .

Reading:

1. Saxena
2. Sastry
3. Hildebrand

Activities:

a. Quiz
b. Assignment
c. Presentation

Module 3: Interpolation (15 Hours)

Finite differences, Forward and Backward differences, Weierstrass theorem (statement only). Interpolation, Newton-Gregory forward and backward interpolation formulae, Divided differences, Lagrange's interpolation formula and inverse interpolation.

Reading:

1. Saxena

2. Sastry
3. Grewal (2013)
4. Hildebrand

Activities:

a. Quiz
b. Assignment

Module 4: Numerical Differentiation and Integration (20 Hours)

Numerical Differentiation: Finding first and second derivatives using interpolation formulae, Difference equations.

Numerical Integration: General quadrature formula, Trapezoidal Rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's rule, Newton-Cotes quadrature formula, Gauss quadrature.

Reading:

1. Milne
2. Hildebrand
3. Grewal (2013)

Activities:

a. Quiz
b. Assignment
c. Presentation