Course Title: Numeric Analysis

Course No. : Math Ed. 455
Level: B.Ed.
Semester: Fifth

Nature of course: Theoretical
Credit Hour: 3 hours
Teaching Hour: 48 hours

1. Course Description

This course is designed for the students of Bachelor level ICT in the Faculty of Education under Tribhuvan University. It helps students to fulfill their increasing desire towards numerical answers to applied problems with the help of methods and techniques of numerical analysis .Although numerical methods have always been useful, their role in the present day scientific research is of fundamental importance. It deals with numerical methods which give the solution when ordinary analytical methods fail for the solution of transcendental equations. In addition, it deals those numerical techniques which can be used for the solution of system of linear equations through matrix computations. This course also discusses for the solution of non-linear equations through interpolation and iterative method of differentiation and integration. This course also provides a foundation for the mathematical modeling in the field of research.

2. General Objectives

- To understand errors and approximation.
- To use different methods for solving transcendental and linear simultaneous equations.
- To define different types of differences and construct their tables ,and establish the relationship between them
- To be familiar with interpolation and apply suitable interpolation formula for numerical problems
- To deal with numerical approximations of derivatives
- To approximate computation of an integral using numerical techniques

3. Course Outlines:

Specific Objectives	Contents
• To identify the types of errors • To derive general error formula • To generalize a series approximation	**Unit 1: Computations and Errors (3)** 1.1. Significant digits 1.2. Errors 1.3. General error formula 1.4. Error in a series approximation
• To discuss the solution of linear equations graphically • To find solution of equations by bisection method • To discuss the method of false position • To solve equations by iteration method • To derive and use Newton-Raphson iteration formula • To approximate roots of an	**Unit 2: Solution of Algebraic and Transcendental Equations (8)** 2.1. Linear equations 2.2. Graphical solution of equations 2.3. Bisection method 2.4. The method of false position 2.5. Iteration method 2.6. Newton – Raphson method 2.7. General Newton's formula for multiple roots 2.8. Muller's method

equation by Muller's method.	
• To apply Gauss elimination method in solving simultaneous equations • To solve simultaneous equations by Gauss - Jordan method • To discuss Jacobi's and Gauss –Seidel iteration method • To discuss and use factorization, iterative and partition method to solve simultaneous equations	**Unit 3: Solution of Linear Simultaneous Equations (6)** 3.1 Gauss elimination method 3.2 Gauss – Jordan method 3.3 Jacobi – Iteration method 3.4 Gauss – Seidel iteration method 3.5. Matrix inversion method 3.6 Factorization method 3.7 Iteration method 3.8 Partition method
• To discuss forward and backward difference operators • To construct difference tables • To discuss properties of the forward difference operator • To establish relationship among the operators E, D and D • To express a given polynomial in factorial notation	**Unit 4: Finite differences (4)** 4.1. Forward difference operator 4.2. Forward difference table 4.3. The operator E 4.4. Relation between the operator E and D 4.5. The operator D 4.6. Backward difference table 4.7. Factorial polynomial
• To identify the central difference and the mean operator • To construct the central difference table • To find relationship between the operators D, Ñ, E, μ and d	**Unit 5 Central differences (4)** 5.1. Central difference operator 5.2. Central difference table 5.3. Mean operator 5.4. Relationship between operators D, Ñ, E, μ and d
• To derive and use Newton-Gregory forward interpolation formula • To derive and use Newton-Gregory backward interpolation formula • To apply forward and backward interpolation formulae in solving problems	**Unit 6: Interpolation with Equal Intervals (5)** 6.1. Newton-Gregory forward interpolation formula 6.2. Newton-Gregory backward interpolation formula 6.3. Error in the interpolation formula
• To discuss linear and quadratic interpolations • To find divided differences • To establish the relationship between divided differences and ordinary differences	**Unit 7: Interpolation with Un-equal Intervals (5)** 7.1. Linear interpolation 7.2. Quadratic interpolation 7.3. Divide differences 7.4. Second divided difference 7.5. Relation between divided and ordinary differences
• To derive and use Gauss' forward and backward interpolation formula	**Unit 8: Central difference Interpolation (8)** 8.1. Gauss' forward interpolation formula 8.2. Gauss' backward interpolation formula

• To apply Bessel's and Stirling's formula for interpolation	8.3. Bessel's formula 8.4. Stirling's formula
• To derive formula for the derivative using forward and backward • To derive formula for derivative using central difference formula	**Unit 9: Numerical Differentiation (4)** 9.1 Numerical differentiation 9.2. Derivative using forward difference formula 9.3. Derivative using backward difference formula 9.4. Derivative using central difference formula
• To derive general quardrature formula • To apply trapezoidal rule, Simpson's one-third rule, three-eight rule • To find errors in quadrature formula • To discuss on deductions from Cote's formula	**Unit 10: Numerical Integration (5)** 10.1 General quadrature formula for equidistant ordinates 10.2 Trapezoidal rule 10.3 Simpson's One –Third rule 10.4 Simpson's Three – Eight rule 10.5 Bool's rule 10.6 Weddle's rule 10.7 Errors in quadrature formula 10.8 Newton Cote's formula 10.9 Deductions from Cote's formula 10.10 Double integration

4. Instructional Techniques

Units	Activities and Instructional Techniques
Unit 1:	Individual and group discussion on calculating errors
Unit 2:	Individual and group discussion on bisection and iteration methods Group and individual assignment on problems of getting roots by bisection method,
Unit 3:	Group and individual discussion on different methods of solving linear simultaneous equation.
Unit 4:	Individual and group assignment on finite difference
Unit 5:	Presentation and discussion on computer programming in c++ of important method.
Unit 6:	Individual and group assignment on forward and backward interpolation formula.
Unit 7:	Individual and group presentation on divided differences and ordinary differences.
Unit 8:	Individual and group assignment to solve problems related to central difference interpolation.
Unit 9:	Discussion on numerical differentiation.
Unit 10:	Group work on numerical integration.

The instructional techniques for this course are divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to particular units.

5. Evaluation :

5.1. Internal Evaluation (40 Points):

Internal evaluation will be conducted by subject teacher based on following criteria:

1) Class Attendance	5 points
2) Learning activities and class performance	5 points

3) First assignment (written assignment) 4) Second assignment (Case Study/project work with presentation) 5) Terminal Examination	10 points 10 points 10 Points
Total	40 Points

5.2 Semester Examination (40 Points)

Examination Division, Dean Office will conduct final examination at the end of semester.

1) Objective question (Multiple choice 10 questions x 1mark) 2) Short answer questions (6 questions x 5 marks) 3) Long answer questions (2 questions x 10 marks)	10 points 30 points 20 points
Total	60 points

6. Recommended books and References materials (including relevant published articles in national and international journals)

Recommended books:

Sastry, S.S. (1990). *Introductory methods of numerical analysis* ,New Delhi : Prentice- Hall of India (Units I – X)

Gupta S. and Sharma S.(2014).*Numerical analysis* ,New Delhi : S.K .Kataria & Sons (Units I – X)

References materials:

Conte S.D. (1965) , *Elementary numerical analysis* Mc Graw- Hill Froberge

C.E. (1965) , *Introduction to numerical analysis* ,Adison Wesley

Jian , M.K.(1971) , *Numerical analysis for scientists and engineers* Delhi:S.B.W . Publishers

Sastry S.S. (1997) , *Engineering mathematics* , New Delhi : Prentice-Hall of India

Stanton, R.G. (1967), *Numerical methods for science and engineering*, New Delhi : Prentice-Hall of India