MATH-352 Numerical Methods					
Credit Hours:	2-1-3	**Prerequisites**	Nil		
Course Learning Outcomes:					
S No	**CLO**		**Domain**	**Taxonomy Level**	**PLO**
1.	Apply different numerical methods to perform polynomial interpolation, curve fitting, differentiation, integration, and estimation of algebraic nonlinear equations.		Cognitive	3	1
2.	Solve ordinary differential equations and compute optimum points in optimization problems using numerical techniques.		Cognitive	4	1
3.	Apply a simulation tool to implement various numerical methods.		Cognitive	3	5
Course Content:					
Introduction to Numerical Analysis: Introduction, Measuring Errors, Sources of Errors, Propagation of Errors, **Solution of Nonlinear Equations:** Bisection Method, Newton Raphson Method, Secant Method, False Position Method **Regression and Interpolation:** Linear Regression, Nonlinear Regression, Adequacy of Regression **Direct Method Interpolation**: Newton's Method of Interpolation, Lagrange Interpolation, Spline Interpolation **Numerical Differentiation and Integration:** Numerical Differentiation, Continuous Functions, Discrete Functions, Numerical Integration, Trapezoidal Rule, Simpson's Rule, Gauss Quad Rule, Improper Integrals **Initial Value Problems for Ordinary Differential Equations:** Elementary Theory of Initial Value Problems, Euler's Method, Finite Differential Method, RungeKutta Methods, Shooting Method, Higher Order Differential Equations **Numerical Optimization:** Golden Section Search Method, Newton's Method, Direct Search Method, Gradient Search Method, Simplex Method					
Teaching Methodology:					
Lectures, Written Assignments, Semester Project, Presentations					
Course Assessment:					
Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam					
Reference Materials:					
1. Numerical Analysis by Richard L. Burden					

2. Numerical Methods with Applications by Autar K. Kaw

MATH121 Linear Algebra and Ordinary Differential Equations

Credit Hours:	3-0-3	**Prerequisites**	MA101 Calculus I

Course Learning Outcomes:

S No	**CLO**	**Domain**	**Taxonomy Level**	**PLO**
1.	Solving system of linear equation using matrices.	Cognitive	1	3
2.	Evaluating Eigen values, Eigen vector and related problems.	Cognitive	1	3
3.	Solving first order and higher order differential equations.	Cognitive	2	5
4.	Carry out Laplace Transform and Inverse Laplace transforms including solution of Initial value problems involving piece-wise continuous functions.	Cognitive	2	5

Course Content:

Matrices: Introduction to Matrices, Elementary row operations, Echelon and reduce Echelon form, Inverse of a matrix by using elementary row operations **Determinants**: Introduction to Determinants, Properties of determinants of order n, Application of determinants **Linear Systems of Equations:** Introduction to Linear systems, Homogeneous and non-homogeneous linear equations, Gaussian Elimination and Gauss-Jordan Methods, Consistency criterion for solution of homogeneous and nonhomogeneous systems of linear equations, Applications of systems of linear equations **Vector Spaces and Subspaces:** Vector spaces and subspaces, Linear combination, Linear independence and linear dependence, Linear Transformations. Eigen Values and Eigen Vectors Introduction to Eigen values and Eigen vectors, Diagonalization, Applications of Eigen values and Eigen vectors **Ordinary Differential Equations:** Differential Equations and their Classification, Formulation of Differential Equations **First Order Differential Equations:** Solution of differential equations, Separable differential equation, Homogeneous differential equation, Exact differential Equations, Integrating factor, Linear differential Equations, Bernoulli differential equations, Applications of first order differential equations **Second and higher Order Differential Equations:** Solution of Homogeneous

Linear 2nd and higher order differential Equations, Solution of nonhomogeneous Linear 2nd and higher order differential Equations, The Cauchy Euler Equation, Application of 2nd and higher order differential equations.
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:
1. Zill, D. G., & Wright, W. S. (2013). Differential equations: with boundary value problems (8th ed.). Boston, MA: Brooks/Cole, Cengage Learning.ISBN-13: 978-1111827069 2. Nielsen, K. L. (1966). Differential equations (2d ed.). New York: Barnes & Noble. ISBN-13:978-0064600729 3. Lay, D. C. (2012). Linear algebra and its applications (4th ed.). Boston: Addison-Wesley. ISBN-13:978-0321385178