Department of Mathematics
Faculty of Mathematics & Computer Science
M.Sc. (Applied Mathematics), 1st Semester

Course Code	AM 102
Course Title	Numerical Analysis & Methods
Course Credits	04

Course objectives:

The main objective of this course is to learn various numerical methods to solve large system of linear and nonlinear equations, to find real/complex roots of high order polynomial equations, to find eigen values of large linear systems and to find integral values of transcendental functions. The main focus of this course will be the implementation of MATLAB program to solve problems numerically.

Minimum pre-requisites:

Differential and integral calculus, Matrix algebra, First level real analysis, Computer programming.

Course structure:

Numerical Solution of Non-linear Equations: Iterative methods based on second degree equation; Muller method; Chebyshev method; Multi-point iteration method; Rate of convergence; Acceleration of convergence; Methods for complex roots; Newton-Raphson method for system of non-linear equations; Multiple roots; Iterative methods for polynomial equations; Birge-Vietta method; Bairstow method; Graeffe's-root squaring method.

Numerical solution of system of Linear Equations and Eigen Value Problems: Ill-conditioned systems and conditioned number; Block-iterative methods (Jacobi, Gauss-Seidel and SOR); Determination of optimal relaxation parameter; convergence analysis; Eigen value and eigen vectors; Jacobi method, Given's method and Householder method for symmetric matrices; Rutishausher method for arbitrary matrices; Power method; Inverse power method.

Interpolation and Approximations: Higher order interpolation; Hermite interpolation; Piecewise and spline interpolations; Cubic spline interpolation; Lagrange and Newton bivariate interpolations; Least-square approximation; Gram-Schmidt orthogonalizing process; Legendre & Chebyshev polynomials; Uniform mini-max polynomial approximation; Chebyshev polynomial approximation; Lancoz economization; Pade' approximation.

Numerical Integration: Method based on undetermined coefficients; Extrapolation and Richardson's extrapolation methods; Optimum choice of length; Gauss-Legendre, Lobatto, Radau and Gauss-Laguerre integration methods; composite integration; Romberg integration; Double integration.

Reading suggestions:

- C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, 7th Edit., Addison-Wesley, Boston, 2003.
- J.H. Mathews and K.D. Fink, Numerical Methods using MATLAB, 4th Edit., Prentice Hall Inc., New Jersey, 2009.
- R.L. Burden and J.D. Faires, Numerical Analysis, 7th Edit., Thomson, New York, 2007.

Evaluation and weightage:

- 30% for Computer practicals
- 10% for Quiz
- 20% for Mid-Term examination
- 40% for End-Term examination