Integrated Ph.D. Programme in Physics

PAPER-II Advanced Computational Methods in Physics

UNIT-I

Gauss-Jordan Elimination, Gaussian Elimination with Back substitution, Iterative Improvement of a Solution to Linear Equations. Polynomial Interpolation and Extrapolation, Cubic Spline Interpolation, Rational Function Interpolation and Extrapolation, Laplace Interpolation.

UNIT-II

Polynomials and Rational Functions, Evaluation of Continued Fractions, Series and Their Convergence, Recurrence Relations. Quadratic and Cubic Equations, Numerical Derivatives, Runge-Kutta Method, Predictor-Corrector Methods.

UNIT-III

Jacobi Transformations of a Symmetric Matrix, Real Symmetric Matrices, Reduction of a Symmetric Matrix to Tridiagonal Form. Givens and Householder Reductions, Eigenvalues and Eigenvectors of a Tridiagonal Matrix, Hermitian Matrices. Improving Eigenvalues and/or Finding Eigenvectors by Inverse Iteration. Fourier Transform of Discretely Sampled Data, Fast Fourier Transform (FFT), FFT of Real Functions, Fast Sine and Cosine Transforms.

UNIT-IV

Moments of a Distribution - Mean, Variance, Skewness. Linear Correlation, Nonparametric or Rank Correlation. Least Squares as a Maximum Likelihood Estimator, Fitting Data to a Straight Line. Straight-Line Data with Errors in Both Coordinates, General Linear Least Squares.

References

- William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, Numerical Recipes: The Art of Scientific Computing, Third Edition (Cambridge, 2007)
- 2. Shastry, S.S., Numerical Methods, (Prentice Hall Inc., India, 1998)
- 3. Balagurusamy, E., Numerical Methods, (Tata McGraw Hill, 1999)
- Scarborough, J. B., Numerical Mathematical Analysis, (Johns Hopkins Univ. Press, 1968)