National Institute of Technology Karnataka, Surathkal
Department of Physics

PH755 Computational Methods in Physics
January – May 2020

Credits : (2-1-0) 3

Instructor : Dr. V. Sreenath

1. **A Quick Introduction to Python :** Basics, control statements, lists and arrays, for loop, user-defined functions, graphics and visualization, error and speed.

   (8 hours)

2. **Integrals and Derivatives :** Trapezoidal rule, Simpson's rule, Romberg method, Gaussian quadrature, Errors and steps, Integrals over infinite ranges, Forward and backward differences, Central differences, Interpolation - linear and cubic spline methods.

   (8 hours)

3. **Solution of Linear and Non-Linear Equations :** Gaussian elimination, back-substitution, LU decomposition, relaxation method, bisection method, secant method, Gauss-Newton method and gradient descent.

   (8 hours)

4. **Ordinary Differential Equations :** Euler's method, Runge-Kutta method, Adaptive step-size.

   (6 hours)

5. **Partial Differential Equations :** Laplace equation - boundary value problem and relaxation method, Initial value problem – Diffusion equation.

   (6 hours)

6. **Random Processes and Monte Carlo Methods :** Random numbers, Gaussian random numbers, Monte Carlo integration, importance sampling, Markov chain method.

   (4 hours)

Text Books :

1. Mark Newman, Computational Physics (2012).
2. Introductory methods of numerical analysis, S. S. Sastry, PHI Learning Pvt. Ltd (2012).
3. A B Downey, Think Python: An introduction to software design (available online).
4. D Potter, Computational Physics, Wiley Newyork NY (1973).
5. W.H. Press, S.A. Teukolsky, W.T. Vettering, and B.R. Flannery Numerical Recipes in C: the art of scientific programming, Cambridge University Press, Cambridge UK (1992).
6. Computational Physics. J. M. Thijssen, Cambridge (2007).

Evaluation scheme :

1. Assignments : 25 marks
2. Mini project : 15 marks
3. Mid Semester Exam : 20 marks (40 mark exam of two hours with weightage of 50%)
4. End Semester Exam : 40 marks (80 mark exam of three hours with weightage of 50%)