Syllabus

MPHY CC 5: Modeling and Simulation (5 Credits)

Unit 1: Object oriented Programming language
Object oriented paradigm with reference to C++: Objects and classes, Encapsulation and data abstraction, Delegation; Inheritance, Polymorphism: function and operator overloading, dynamic binding; message communication; Elementary idea about Fortran, Java and Python (Basic features only).

Unit 2: Programming with Python
Program development, Variables, Expressions and statements, Functions, Conditionals and Recursion, Iteration, Strings, Lists, Dictionaries, Tuples, Files, Types of errors and Debugging, Function Libraries, Numpy, Scipy, Matplotlib, Use of Scilab and R for scientific programming.

Unit 3: ODE and PDE
ODE: RK method, Leap Frog method; Application to electron motion in electric and magnetic fields; Non-linear equations; PDE: Elliptic equations: Poisson equation; Hyperbolic equations: wave equation; Parabolic equation: Diffusion equation for Lagrangian fluids.

Unit 4: Matrix Problems
Jacobi method for matrix inversion; Techniques for solving eigenvalue problems

Unit 5: Monte Carlo method and simulation
Random number generators, Monte Carlo integration, Metropolis algorithm, lsing model, Molecular dynamic.

References:
l. Rubin H. Landau, Manuel J. Paez, Computational Physics-Problem solving with computers, John Wiley & sons, New York (1997).
2. P.L. DeVries, A First Course in Computational Physics, John Wiley & sons, New York (1994).
3. G. Golub and J.M. Ortega Scientific Computing: An Introduction with Parallel Computing, Academic Press, San Diego (1993).
4. J. M. Thijssen, Computational Physics, Cambridge University Press, Cambridge, (1999).