BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-Pilani,
Hyderabad Campus
INSTRUCTION DIVISION
FIRST SEMESTER 2015-2016

Course Handout (Part II) Date: 1-8-2016

Course No.: PHY F 313
Course Title: Computational Physics
Instructor-in-charge: P.K.Thiruvikraman

Course Description: The use of computers for computation and simulation has become an integral part of physics. This course gives an introduction to the basic computational methods, which are used to solve problems in Physics. Some of the topics, which will be covered, are numerical methods for finding roots (with special emphasis on transcendental equations), solution of differential equations, integration (including Monte Carlo techniques for evaluating integrals). Applications of these techniques will also be discussed in class. Application oriented take home assignments will be given during the course.

Scope and objective of the course: The objective of the course is to give an introduction to basic techniques for solving Physical problems by using computational methods. Most of the real-world problems are not solvable analytically. An advantage of computational physics is that one can start with an idealized (simplified) version of a real problem for which analytical solution exists. Once a program has been written which can handle the idealized case, we can add more and more complex real-world factors. Illustrative examples will be taken from various areas of Physics like Mechanics, Condensed Matter Physics, Electricity and Magnetism, Quantum Mechanics, Statistical Physics etc. Some of the modern topics like Chaos, Percolation and random walk, will also be covered in the course.

Text Book:

First course in Computational Physics by Paul DeVries, Javier E. Hasbun, Jones and Bartlett Publishers, Indian edition, 2011

Reference Book:

1. Numerical Recipes in C, 2nd Edition, W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, Cambridge University Press, 1992.
2. An Introduction to computer simulation methods, 2nd Edition, Harvey Gould and Tobochnik, Addison Wesley,1996.
3. Applied Numerical Analysis, 7th Edition, Gerald and Wheatley, 2003

Course Plan

Lecture No.	*Learning Objectives*	*Topics to be covered*	*Reference Chap./ Sec. No. (Book)*
1.	Introduction	Introduction	-
2-6	Finding the Roots of a function	The Newton Raphson Method and its application	Chap 2 (TB)

7-10	Interpolation and approximation	Lagrange interpolation, Newton-Gregory interpolation polynomial, error in interpolation	3.1, 3.8
11-16	Numerical Integration	Gaussian Quadrature and application, Romberg integration	Chap 4 (TB)
17-22	Numerical Integration	Random Number generators, Metropolis Algorithm, Monte Carlo Integration and its application	12.6 (R2) & class notes, 11.8 (R2), Chap 4 (TB) & Chap 11 (R2)
23-28	Ordinary Differential Equations	Euler Methods, higher order Runge-Kutta Methods and application	Chap 5 (TB), Chap 16.1-16.3 (R1)
29-32	Partial Differential Equations	Solution of boundary value problems by finite difference methods and application	Chap 7 (T1) Chap 10.2-10.4 (R2)
33-37	Monte Carlo Simulations	Random walk; Ising model	Chap 4 (T1); Chap 5 (T1), Chap 17 (R2)
38-42	Solution of Non-linear differential equations	Chaos	Chap 6 (T1)

Evaluation scheme:

Component	Duration	Weightage(%)	Date & Time	Remarks
Test I	50 min	20 %	10/9/2016 10-11 AM	Open Book
Test II	50 min	20 %	22/10/2016 10-11 AM	Closed Book
Assignments		20 %		Open Book
Compre. Exam	3 hrs	40%	9/12/2016 2 PM – 5 PM	Closed Book

- **Chamber Consultation hour** will be announced in class..
- **Notices** for this course will be displayed on the Physics Notice board and on the Course Management System (CMS) website only.
- **Make-up** will be granted only if the make-up letter is forwarded by the Chief Warden.

Instructor-in-charge,
PHY F313