FIRST SEMESTER 2015-20156

Course Handout (Part-II)

Course No.: PHY F 313

Course Title: Computational Physics

Instructor-in-charge: NAVIN SINGH

1. Course Description:

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 solution of Differential Equations, Monte Carlo Techniques for Evaluating Integrals. Applications of these techniques will also be discussed.

2. Scope and objective of the course:

The objective of the course is to give an introduction to basic numerical techniques which are used in various areas of Physics, like Mechanics, Electricity and Magnetism and Optics. The application of the numerical techniques to some of the problems from Classical, Quantum and Statistical Mechanics will be discussed. Some of the modern topics like Chaos, Percolation, Random Walk Problems and Ising Model will also be discussed.

3. Text Book:

1. **An Introduction to Computational Physics** by Paul DeVries, *John Wiley & Sons,* I Indian edition, 2011
2. **An Introduction to Computer Simulation Methods**, Harvey Gould and Tobochnik, *Addison Wesley*, II Edition, 1996

4. Reference Book:

1. **An Introduction to Computational Physics**, Tao Pang, *Cambridge University Press,* II edition, 2008
2. **Computational Physics**, N.J. Giordano, H. Nakanishi, Pearson Prentice Hall, II edition, 2006

5. Course Plan:

Lecture	Learning Objectives	Topics to be covered	Reference
1-2	Introduction & programming language	Introduction	-
3-4	Finding the Roots of a function	The Newton-Raphson Method	2.1-2.4 (T1)
5-7		Particle in square well	2.11-2.18 (T1)
8-10	Numerical Integration	Gaussian Quadrature	4.1-4.5, 4.12, 4.13 (T1)
11-12		Monte-Carlo method	4.20 (T1), 11.7-11.8 (T2)
13-14		The simple pendulum	4.9 (T1)
15-16	Ordinary Differential Equations	Euler Methods	5.1, 5.2 (T1)
17-19		Runge-Kutta Methods	5.3-5.6 (T1)
20-21		van-der Pol Oscillator	5.10 (T1)
22-23		Finite Differences	5.22 (T1)
24-25	Partial Differential Equations	The vibrating string	7.1-7.5 (T1)

26-27	Monte Carlo Simulations	The Demon Algorithm	16.3 (T2)
28-29		The 1d classical ideal gas	16.4 (T2)
30-31		The Metropolis Algorithm	17.2 (T2)
32-33		Ising Model	17.4 (T2)
34-37	Molecular Dynamics	Classical System	8.1-8.2 (R1)
38-40		The Verlet Algorithm	8.3 (R1)

6. Evaluation Scheme:

Component	Duration	Weightage(%)	Date & Time	Venue	Remarks
Mid Term	90 min	30 %	10/10 2:00 - 3:30 PM		Close book
Tutorials	15 min	20 %	Announced		Close Book
Assignment	-	10 %	Announced		Open book/source
Comprehensive Exam	3 hrs	40%	14/12 FN		Partially close book

7. Issues related with the assignments, computational problems, programming etc. will be discussed in tutorial hours (preferably). These tutorials will be mandatory for the students to attend.

8. Chamber Consultation hour: To be announced in class.

8. Notices: All notices concerning this course will be displayed on the Notice board of on **Nalanda** and Department of Physics.

9. Make-up Policy: Very rare; will be given only in genuine cases, *i.e.*

(i) Sickness leading to hospitalization.

(ii) Going Out-of-Station with prior intimation and permission.

Instructor-in-charge

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