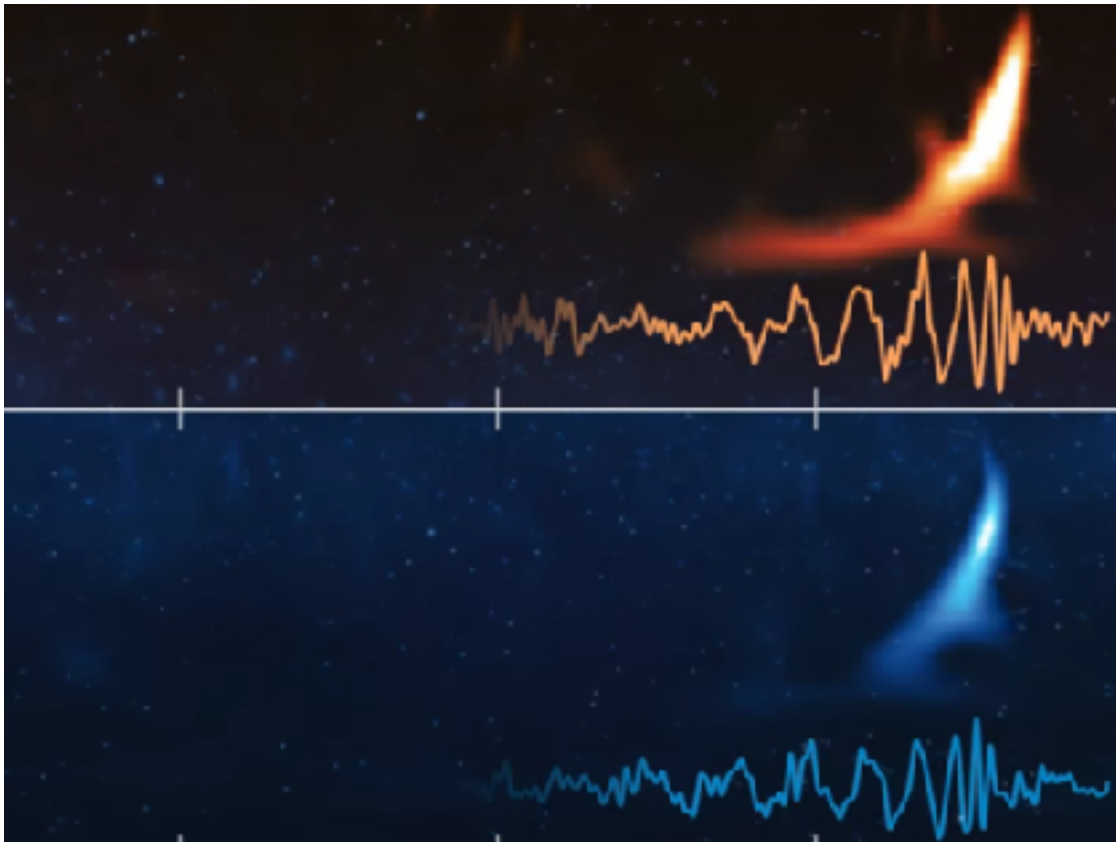
Foundations of Computational Physics

PH1050: May-June 2022

Last Modified - 1 May 2022

Prepared by: Chandra Kant Mishra



Course Instructor:
Chandra Kant Mishra
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Teaching Assistants:
Divyajyoti (PH19D057@smail.iitm.ac.in) [On Leave until May 30]
Kaushik Paul (PH19D018@smail.iitm.ac.in)
Laxman (PH20D008@smail.iitm.ac.in)

Note: This is a live document and will be updated time to time.

Schedule and Office hours

This course will comprise of about **24** lectures (50 minutes each) and **12** hands-on sessions (2 hours 50 minutes each).

The first lecture will be on **Monday, May 2**.

May 2 - 12, 2022

We shall meet on **Mondays** [13:00-13:50PM & 17:00-17:50PM] **and Thursdays** [15:00-15:50PM & 17:00-17:50PM (H slot)] for lectures and on **Thursdays** and **Fridays** during 9:00-11:50AM for hands-on sessions in the **ONLINE mode.**

We shall reserve an additional **Friday** — 14:00-14:50PM (G slot) for lectures in case a class is cancelled due to unforeseen circumstances.

May 13 - June 24, 2022

We shall meet on **Mondays** [13:00-13:50PM & 14:00-14:50PM] **and Thursdays** [10:00-10:50PM & 14:00-14:50PM] for lectures and on **Thursdays** and **Fridays** during 15:00-17:50AM for hands-on sessions in the **ONLINE/OFFLINE mode**.

Students can consult me or the TAs outside the lectures and hands-on sessions after seeking an appointment by email. The respective email addresses appear on the front page of this document.

Lectures

Name	Email	LINK (lectures)
Chandra	ckm@@smail.iitm.ac.in	meet link / CRC 202

Labs

Name	Email	LINK (lectures)
Divyajyoti	PH19D057@smail.iitm.ac.in	meet link / CRC 202 (tentative)
Laxman	PH20D008@smail.iitm.ac.in	
Kaushik	PH19D018@smail.iitm.ac.in	

Grading Plan*

The grading plan for the course is as follows :

- Assignments** : 30 marks
- Mid-term : 20 marks
- End Semester : 50 marks

* To be approved by the class committee.
** Due dates for assignment submission will be announced in the class.

Examination Dates (Tentative)

- Mid-term : May 30, 2022 (3:00 - 5 PM)
- End Semester : July 4, 2022 (3AM - 6 PM)

Preparation for the course

You should have access to a laptop or desktop (preferably with Unix based OS [GNU/Linux, Mac OS X, etc.]).

Mathematica

You must have Mathematica installed on your laptop/desktop. The package can be downloaded from the Wolfram website.

Detailed instructions for obtaining the activation key are outlined in a pdf (mathematica_installation_guide.pdf) being made available on **google drive** folder shared with you.

Python

Make sure you have a recent version of Python (see https://www.python.org/downloads/) along with numpy (http://www.numpy.org/), scipy (http://scipy.org/) and matplotlib (http://matplotlib.org/) libraries installed.

Basic tutorials as well as installation instructions can be found on https://www.python.org/about/gettingstarted/.

JupyterLab

We shall be using Jupyter notebooks for lectures/labs/assignments. Please take a walk through the page (https://jupyter.org/index.html) and install jupyterLab compatible with you python installation following the instructions on https://jupyter.org/install.

Note: If you don't have python already installed you might want to go ahead with installation of jupyterLab using anaconda distribution (https://www.anaconda.com/downloads) which installs python along with Jupyter packages. However, if you have python installed (or for instance you followed the instructions above to first install python) you can use the python package manager 'pip'. Installation instructions using pip and anaconda appear on https://jupyter.org/install.

Course Structure

Overview of various interactive platforms (Mathematica, Matlab, Python and other programming languages) and their utility in Physics

Data Analysis and Numerical Problem Solving through Mathematica : Preface of Mathematica (What Mathematica is all about, how it works, few basic commands); Functions; Plotting of multi-variable functions; 2D and 3D visualisations; Polynomial data fitting (linear, least square, spline); Data interpolation; Probability and Statistics; Regression analysis; Error analysis, Random number generator; Solving algebraic expressions, Numerical precision; Matrix algebra: Finding eigenvalues and eigenvectors; Calculus: Differentiation and Integration.

—Mid-Term—

Learning through Python : Introduction to Python, Basic Commands, Importing Modules (Numpy, Scipy, Matplotlib). Revisit of the problems and concepts discussed in part-A through Python

Application of Mathematica/Python to solve problems in physics : Central Force Problem, Harmonic Oscillator, Waves & Oscillations, Electricity and Magnetism, Data Analysis

—End Semester—

Textbooks

- S. Wolfram, The Mathematica Book (5th Ed.), Champaign, IL: Wolfram Research (2003) 2.
- Alex Martelli, Phython in a Nutshell (2nd Ed.) O' Reilly, CA, 2006

Additional Texts

- R. L. Zimmerman, F. I. Olness, Mathematica for Physics (2^{nd} Ed) Addison Wesley (2002)

- M. Lutz, Learning Python, (5th Ed.) O'Reilly, CA, (2013)

Web resources

- http://www.wolfram.com/mathematica/resources/
- http://www.openbookproject.net/thinkcs/python/english2e/