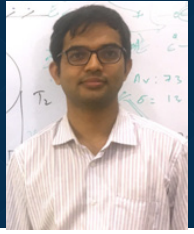

# PHYSICS THROUGH COMPUTATIONAL THINKING

**PROF. AUDITYA SHARMA**
Department of Physics
IISER Bhopal

**PRE-REQUISITES :** Newtonian Mechanics, Modern Physics, Electrostatics.

**INDUSTRIES APPLICABLE TO :** Quantitative Finance and Scientific consulting companies

**COURSE OUTLINE :**

This course gives a hands-on introduction to computational thinking applied to basic undergraduate Physics. A strong emphasis is placed on translating physics problems into a form suitable for analysis on a computer, with visual aids and computer programming tools. The focus here is primarily to develop the cognitive skill of computational thinking in Physics rather than elaborate numerical methods or exhaustive study of Physics. Our approach to problem solving is as follows:

a) Formulate a basic problem that is amenable to full analytical solution.

b) Translate the problem into a form that can be analyzed on a computer, first by visual tools followed by more sophisticated computational tools.

c) Design complementary computational approaches whose results can be subjected to test against the analytical solutions, thus building confidence and making transparent both the methods.

d) Exploit the confidence thus developed to tackle problems that are not amenable to a full analytical solution.

**ABOUT INSTRUCTOR :**

Prof. Auditya Sharma: Got a B.Tech in Engineering Physics from IIT Madras in 2006, followed by a PhD in Physics with specialization in Statistical Physics from the University of California at Santa Cruz in 2011. He followed this with two postdoctoral stints: one at the International Institute of Physics, Natal, Brazil from 2011-2013, and another at Tel Aviv University, Israel from 2014-2015. He has been on the faculty in the Department of Physics at IISER Bhopal since 2015.

**COURSE PLAN :**

**Week** 1 : Intro to Computational Thinking, Visual Thinking and Mathematica

**Week** 2 : Dimensional Analysis, non-dimensionalization, scales of a physical problem

**Week** 3 : Data Analysis: Estimation of errors, and curve fitting

**Week** 4 : Periodic motion 1: simple, damped, and anharmonic oscillators

**Week** 5 : Dynamics through numerical methods: Euler, RK methods.

**Week** 6 : Periodic motion 2: forced oscillations, resonance, friction.

**Week** 7 : Intro. to Monte Carlo simulation

**Week** 8 : Intro. to random walks