Computational Physics Laboratory

Computational physics is an amalgamation of theoretical modelling, numerical algorithms, and programming. The required tools include concepts from physics, computer science, and applied mathematics. It acts as a bridge between theoretical and experimental scientific exploration of natural phenomena occurring in various areas, for instance, materials science, atmospheric science, molecular modelling, optical and quantum system modelling, fluid dynamics, protein folding, electronic circuit design, etc.

The Department of Physics at IIT Jodhpur offers a couple of elective courses related to the subject matter, namely, Computational Physics, Computational Materials Science, and Computational Condensed Matter Physics to instil the deep understanding of techniques in computational physics. The computational physics laboratory at the introductory and advanced level for M.Sc./Ph.D. students will enhance the learning experience of these courses in a great detail. Furthermore, as these courses are elective in nature, it will attract the attention of students from other streams of science and engineering as well.

The laboratory is equipped with several state-of-the-art workstations with multiple operating system environments. A number of computational and simulation programs including MATLAB® and Mathematica® are pre-installed. The standard flow of activities in this laboratory is to formulate/model the real-world and multi-Physics phenomena; develop algorithm; write code; execute the job on a computer; visualize and analyse obtained data; and finally, correlate/verify the results with the observed phenomena.

The lab aims to strengthen the fundamentals of computational physics for students from physics, chemistry, mathematics, engineering and related disciplines. The activities in the laboratory will enable students to gain a deeper insight of methods in computational physics by developing numerical algorithms and building these via computer programming. Apart from having hands-on experience with the state-of-the-art equipment, the students will learn/enhance the following:

- Coding in different programming languages
- Scripting in shell, awk, perl, etc.
- Computational modeling and development of algorithms
- Data visualization (plotting), animation and data analysis (coding/scripting),
- Presentation skills (PowerPoint/Latex)
- Advanced problem solving
- Research skills
- Hands-on experience with computer hardware and software
- Basics of clustering and networking

A list of computer experiments designed to encompass the above objectives is as follows:

S. No.	**Name of Experiment**
1.	Implementation of nonlinear root finding techniques
2.	Interpolation techniques
3.	Curve fittings
4.	Solving ordinary differential equations
5.	Simulations of physical systems, Monte Carlo technique, etc.
6.	Solution of Schrödinger like equation
7.	Solution of Helmholtz equation (Propagation study)
8.	Quantum Simulation