Teaching Computational Physics in Jadavpur University

Jadavpur University is located on the south fringe of Calcutta.

Students come from the city (30 – 60 %) as well as from suburban and rural areas (40 – 70 %).

Physics teaching:

Undergraduate honours level: 40 – 45
Undergraduate subsidiary courses: ~140
Undergraduate Engineering: ~1200

Postgraduate (day): ~35
Postgraduate (evening, school teachers etc): ~35
Undergraduate teaching includes:

2 semester course in computer applications → 2\textsuperscript{nd} Year B.Sc.

Till 1999 – Introduction to Fortran
From 2000 – Introduction to C
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Advantage: Basic course, compulsory to all science students, interdepartmental initiative
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Advantage: Basic course, compulsory to all science students, interdepartmental initiative

\textbf{Disadvantage}: No Major-subject specific tailoring, Not enough application in the major (honours) subject
Postgraduate teaching includes:

2 semester course in Fortran Programming and Numerical Methods → 1st Year (since 1988)

Errors in numerical computation

Solutions of equations: Bisection, Secant, Newton-Raphson Method.

Finite Differences

Newton and Lagrange interpolation

Euler method, Runge-Kutta method

Method of least squares

Matrix eigenvalues

Numerical integration: Trapezoidal and Simpson's method
Postgraduate teaching includes:

2 semester course: **Computer Applications in Physics** → 2\(^{nd}\) Year M.Sc. (since 1995, UGC special assistance)
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1. Review of Fortran
2. Introduction to Mathematica
Postgraduate teaching includes:

2 semester course: **Computer Applications in Physics** → 2nd Year M.Sc. (since 1995, UGC special assistance)

1. Review of Fortran
2. Introduction to Mathematica
3. Classical Mechanics
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1. Review of Fortran

2. Introduction to Mathematica

3. **Classical Mechanics** – Motion of point particle, Orbits in central force field, solution of Hamilton's equation, non-linear dynamics, Bifurcations, Duffing oscillator, van-der Pol oscillator, Lorenz equation, Chaos.
Postgraduate teaching includes:

2 semester course: **Computer Applications in Physics** → 2\textsuperscript{nd} Year M.Sc. (since 1995, UGC special assistance)

1. Review of Fortran
2. Introduction to Mathematica
4. Quantum Mechanics
Postgraduate teaching includes:

2 semester course: Computer Applications in Physics → 2nd Year M.Sc. (since 1995, UGC special assistance)

1. Review of Fortran
2. Introduction to Mathematica
4. Quantum Mechanics – Time evolution of wave packet, Bound state energies and wave function, scattering of wave packet at potential step.
Postgraduate teaching includes:

2 semester course: **Computer Applications in Physics** (since 1995, UGC special assistance) → 2nd Year M.Sc.

5 **Statistical Physics**
Postgraduate teaching includes:

2 semester course: **Computer Applications in Physics** → 2nd Year M.Sc. (since 1995, UGC special assistance)

5 **Statistical Physics** – Random numbers and variables, Monte Carlo simulation, random walks, approach to equilibrium, Metropolis algorithm, Ising model
Impact of the course on students – some instances
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Present: post doc at T.U., Dresden
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Comput'l Phys Proj: Chaos in Dynamical Systems
Ph.D. Univ of Delaware, 2008.
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    Comput'l Phys Proj : Surface Growth – Ballistic-Random Deposition Process
    Present : Research fellow at Jadavpur University
Impact of the course on students – social relevance
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Maitreyi Banerjee – B.Sc. (CU) – 1987
discontinued study for raising family,
M.Sc. (JU, evening) – 2004
Presently with Lucent Technologies.
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• Some analytical results were also found for general power law forces.

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Presently Headmaster in a Calcutta school.

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Presently Headmaster in a Calcutta school.

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- Implemented computer laboratory (12 computers) in school with assistance from alumni and NGO.
- Introduced a Computer Applications course for school students. It is an optional course at secondary level in WB.
- Students can also play with applets as an aid to their school books.
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5. How good are my random numbers? (Chi sq. test etc.)
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   i) Product of an increasing and a decreasing function has a maximum. Is that always true?
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2. Statistical Mechanics –
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3. Classical mechanics –
   i) How do we define virtual displacement?
   Is principle of zero virtual work a definition (it is not), or an additional condition on the system of virtual displacements?
What do I expect from a meeting like the present one:

- Exchange experience and ideas (may continue through email)
- Discuss common core curricula
- Evolve realistic and effective method of feedback from students
- Hold discussion sessions for continuous improvement in future
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There will always be twists and turns, but a paved road can lead to more exotic beauty of nature.