# Computer programming course in the Department of Physics, University of Calcutta

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with inputs from

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and feedback from students

# Present syllabus

Brief introduction to computation.

Part A: FORTRAN Language (10 classes approx)

Constants and variables.
Assignment and arithmetic expressions.
Logical expressions and control statements
DO loop, array
Input and output statements
Statement function, function subprogram and subroutine.

# Syllabus...contd

Part B: Numerical analysis (12-15 classes)
Computer arithmetic and errors in floating point representation of numbers

Different numerical methods for

(i) finding zeroes of a given function
(ii) solution of linear simultaneous equations
(iii) numerical differentiation and integration
(iv) solution of first- order differential equations
(v) interpolation and extrapolation
(vi) least square fitting.

# Methods

Zeroes of a given function : Successive approximation, bisection method, Newton Raphson method.

Solution of linear sim equations : Gauss Seidel method, Gauss iteration method

Numerical Integration : Trapezoidal and Simpson's 1/3 rule

Differential equations - Euler method, Runge Kutta 2nd order methods, Runge Kutta 4th order
Also 2nd order DE using Euler's method.

Interpolation and extrapolation: Lagrange's method

# Details

We have one paper of 50 marks.

Course is taken over two semesters and exam taken at the end of 2nd sem.

Class of 70 students split into groups of 14.

Each group attends one practical class per week.

Two students allotted one machine.

# Problem sets

About 5-8 problems in each set.

5-6 problem sets assigned per semester.

First sem - problems based on language and algorithms

Second - Numerical analysis.

# Problems

Typical algo based problems:

Problems on series (e.g., trigonometrical, special functions) and sequence (Fibonacci etc.) with convergence testing, prime number and other problems based on numbers, sum of digits, problems on matrix operations, combinatorial problems, random number generation, sorting etc.

Some Physics related problems like random walk, counting of degeneracy, calculating Lyapunov exponent (logistic equation) etc.

# Exam

Format of examination not very rigid

Exam - One theoretical exam mid semester
(Marks scaled down to 10)

Two problems set in the final exam - one algo based the other on numerical methods - 15-20 marks each.

Also viva of 10 marks (during exam).

# Observations

- We are quite conscious that the present course, at the master's level, may seem rather elementary.

But...

Both the background and standard of the students have very wide distributionis. (Problem faced in other courses as well.) Most of the students feel the course is okay.

- Still, to cater to the best students, we sometimes set optional problem sets of a higher standard. Response is not very encouraging! (Reason - exam and marks oriented mentality)
- However, the students joining research later do not really find it difficult to use computational methods

# How to help the better students?

Very soon, it will be possible to allot one machine per student.

In one elective course (Advanced Statistical Mechanics), we do teach some simulation methods - still at a theoretical level.

In the fourth semester, students are required to do a project which may involve computations.

There have been thoughts on introducing a course on Computational Physics (strictly as an elective course) to train students on research oriented computations.