Numerical Methods in Physics and Computational Techniques

Instructor: **Dr. Nabin K Malakar**
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Mention PHY3330 in the subject line
Office Hours: Mon10-11A Room # ECSN 2.206
Teaching Assistant: Chunlei Qu { cxq120830 { @} utdallas.edu}
TA's office hour: Wed 2-4PM (FN 2.206)

Class: Tuesday & Thursday, 7:00pm-8:15pm ECSN 2.126

Course Objectives:

Students will learn to use existing mathematical and computer tools with a view to application in physical problems.

Course Description:

The course covers concepts and computational techniques in numerical methods for solving physics problems. Topics typically include probability, statistics, data analysis, fits, numerical solutions, and interpretation of the experimental data. 3 Credits.

Course Website: This course has a web site. http://bit.ly/PHYS3330
Prerequisite(s)
MATH 2415 or MATH 2419 and MATH 2418.

Course Policy:

- Class attendance is required for this course
- Students are highly encouraged to work together on problems. That is how scientists work. However, each student must prepare his/her own solution. COPYING IS STRICTLY PROHIBITED and will be reported to the Dean's office.
- You must show all work for written assignments.

Software: Matlab Release 14 (or later): Student Version
Homework:
There will be written and programming homework, which will be posted on the course website. They are normally due in a week. Students should work on these problems, and turn in the homework on the due date marked on the assignment. Homeworks turned in after the due date will have have 20 points deducted from the final score. In many cases, the system might not accept late homeworks after 5 days. Do not be late.

The grade of the course will be based on the homework (50%), and the final exam/project (50%).

Homework submission:
Upload the assignment solution as one single zip file to the eLearning website. If the site does not work, send it to TA's Email address. If your code does not run in TA's computer, you will be assigned ZERO score. So, double check before you hit the "send" button.

Take home Final:
The final exam will be a take home exam/project. You are not supposed to discuss this one with your peers. ONLY you must do the final.

Reference Books

- "Numerical Methods for Physics", A. L. Garcia, ISBN 0-13-906744-2, Prentice Hall, Inc.
- "Computational physics: problem solving with computers", Rubin H Landau, Manuel José Páez Mejía, and Cristian C Bordeianu, ISBN 3527406263, Wiley, John & Sons.
- "Statistics for Nuclear and Particle Physicists", Louis Lyons, Cambridge University Press, ISBN 0 521 37934 2
- "Numerical Recipes in C", William H. Press *et al*., Cambridge Univ. Press
- "Numerical Methods for Scientists and Engineers", R.W. Hamming
- "A Course in Probability and Statistics", Charles J. Stone

Grading:
Written Homework : 25%
Programming H/W: 25%
Final Project: 50%

Course:
Basic elements of MATLAB
Simple programs; Precision & round-off
Interpolation, Examples
Integration
    Integrating using Matlab functions
    Applications
    Understanding the computational Methods for Integration
        Quadrature Rule
        Trapezoid Rule
Differentiations

- Applications

- Differential Equations
  - Using ODE solvers
  - ODE Algorithms
    - Euler's Method
    - Runge-Kutta Method
- Partial Differential Equation
- Fourier Analysis
- Applications
  - General Physics
    - **Electric Potential**
    - **Baseball motion including Spin**
  - Quantum Mechanics
    - **Finding Roots by Newton's Rule**
    - **Particle in a Box**
  - Statistical Mechanics
    - Brownian motion
    - **Ising Model**
- **Optimization Techniques**
- **Probability and Statistics**
- **Markov Chain Monte Carlo**