KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
DEPARTMENT OF PHYSICS

Physics 373 – Introduction to Computational Physics – Winter Semester 2023 (Term 222) Course Schedule and Grading Policy

Course Description:
Computer Simulation of Physical systems. Topics covered: simulation techniques; programming methods; comparison of ideal and realistic systems; limitations of physical theory; behavior of physical systems.

Pre-requisite: PHYS 212 and ICS 101 (or 102 or 103)

Lecture Hours: UT (12:00-12:50)
LAB Hours: W (12:00-2:50 PM)
Office Hours: UMT (01:00-1:50 PM)

Textbook: "Computational Physics: Problem Solving with Computers", by Landau, Paez & Bordeianu, Wiley (2012).
Supplementary Books:
(A) Numerical Analysis, Ninth Edition. Richard L. Burden and J. Douglas Faires
(B) Python For Everyone, 2rd Edition, Cay S. Horstmann, Rance D. Necaise

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Grading Policy

Grading Policy	%
Classwork Quizzes (10%) + LAB work (15%)	25
Projects	15
MidTerm Exam	30
Final Exam	30
Total	100

Physics 373 Lecture Schedule
Spring 2023 (Term 222)

Week	Date	Topics	Lab Assignment
1	15 Jan 19	Introduction to Computational Physics. Programs: Language and Structure	No Lab
2	22 Jan 26	Error Analysis and Uncertainties Taylor Theorem	Programming with python
Thursday – 26th Jan. 2023- Last day for dropping courses without permanent record			
3	29 Jan 02 Feb.	Solving Nonlinear Equations: | Bisection method | Secant method	Error Analysis Taylor Theorem
4	05 Feb. 09	Numerical Roots of equations: | Regula-Falsi method | Newton-Raphson	Root-Finding (Bisection method)
5	12 Feb 16	Systems of Linear Equations: Naive Gaussian Elimination	Root-Finding Newton-Raphson
6	19 Feb. 23	Systems of Linear Equations: Gaussian Elimination | Algorithm for Tri-diagonal Equations	Systems of Linear Equations
7	26 Feb 02 Mar	Curve Fitting: Least Squares Linear Regression | Nonlinear Problems	No Lab
8	05 Mar. 09	Interpolation: Newton Polynomial Interpolation Lagrange's interpolation:	Curve Fitting
9	12 Mar. 16	Numerical integration methods: Trapezoidal rule | Simpson's rules | Monte Carlo	Interpolation
10	19 Mar 23	Ordinary Differential Equations: Runge-Kutta Methods	Numerical integration
Midterm Exam: TBA			
11	26 Mar 30	Partial Differential Equation in Physics Finite Difference algorithms for PDE	ODE
12	02 Apr 06	The Laplace and Poisson equations Time-dependent Heat Equation	PDE
13	09 Apr 13	Quantum mechanical Calculations: The Density-Functional Method (DFT)	PDE (applications)
Eid Al-Fitr Holidays: Apr. 14th - Apr. 27th 2023			
14	30 Apr 04 May	Molecular Dynamics Simulation Method / Ising model	MD | Ising model
Thursday - 04 May 2023: Last day for major exams; Last day for withdrawal from all courses with grade of "W"			
15	07 May 11	Presentations Presentations	No Lab
Final Exam: TBA			

Attendance Policy:

PHYS 373 course is offered in person. Class attendance and participation are required.

- A **DN** grade shall be given to the student who has more than **12 unexcused absences** in lectures.
- A Student who has a valid excuse (from KFUPM clinic or Students Affairs) for his absence must present it to his instructor no later than one week after resuming classes

Course Learning Outcomes PHYS-373

On completion of the course, the student should be able to:

- Design and implement working Python code.
- Understand the basic principles of numerical methods and their application to solving physics problems.
- Be able to write computer programs to solve physics problems numerically.
- Be able to use numerical methods to model physical systems and analyze the results.
- Understand the limitations of numerical methods and the trade-offs between accuracy and computational time.
- Be able to critically evaluate the results of numerical simulations and compare them to analytical solutions and experimental data.
- Understand the importance of parallel computing and distributed computing in computational physics.
- Be familiar with the use of common programming languages and software packages used in computational physics.