

# **Physics 373**

# **Intro to Computational Physics**

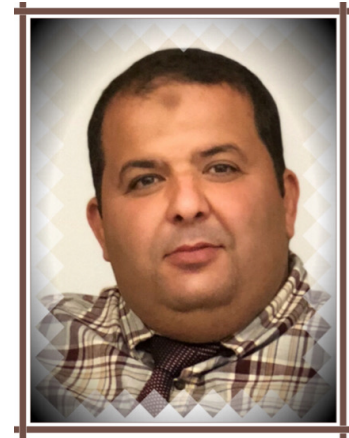
**Dr. Sabri Elatresh**

**Term 222: 2023**



**Physics 373**  
**Department of Physics**  
**King Fahd University of**  
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**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, 2nd Edition, Cay S. Horstmann, Rance D. Necaise

**Grading Policy**

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

**Attendance Policy:**

**1. 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.

## 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.

## 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
<b>Thursday – 26th Jan. 2023- Last day for dropping courses without permanent record</b>			
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
<b>Midterm Exam: TBA</b>			
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)
<b>Eid Al-Fitr Holidays: Apr. 14th - Apr. 27th 2023</b>			
14	30 Apr 04 May	Molecular Dynamics Simulation Method / Ising model	MD   Ising model
<b>Thursday - 04 May 2023: Last day for major exams; Last day for withdrawal from all courses with grade of "W"</b>			
15	07 May 11	Presentations Presentations	No Lab
<b>Final Exam: TBA</b>			