KINGDOOM OF SAUDI ARABIA
Ministry of Education
Al Imam Mohammad Ibn Saud Islamic University
College of Science
Department of Physics

المملكة العربية السعودية
وزارة التعلـيـم
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم
قسم الفيزياء

SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Language
PHY	436	Computational Physics	3	2	0	2	5	PHY 334, CS 140	7	English

A. Course Description

Computers and computation are extremely important components of physics and should be integral parts of a physicist's education. Furthermore, computational physics is reshaping the way calculations are made in all areas of physics. This course covers the different types of computational problems using a programming language with exercises developed around problems of physical interest.

B. Course Outcomes

At the end of this course the student will be able to:
1. Formulate a physical problem in a manner suitable for computational solution.
2. Construct a working, structured program in programming language that includes standard numerical procedures to solve a physical problem.
3. Employ appropriate numerical method to interpolate and extrapolate data collected from physics experiments.
4. Develop critical thinking and analytical problem-solving skills.

C. References

- Riley K.F., Hobson M.P., and Bence S.J., *Mathematical Methods for Physics and Engineering,* 3rd Edition, Cambridge University Press, 2006.
- Arfken George B., and Weber Hans J., *Mathematical Methods for Physicists,* Academic Press, 6th Edition, (2005).
- Kreyszig E., *Advanced Engineering Mathematics*, John Wiley & Sons , INC 8th Edition (1998).
- Nicholas J. Giordano and H. Nakaanishi, *Computational Physics,* Addison-Wesley, (2006).
- Koonin Steven E., *Computational Physics,* Addison-Wesley, New York, (1989).
- Pang, T., *An Introduction to Computational Physics,* Cambridge University Press, (2006).
- Fitzpatrick R., *Computational Physics,* Texas University Press, (2006).

Course Website: http://www.imamm.org/

D. Topics Outline

1. *Introduction: Overview - A programming language: computer algorithms and languages, Using different software's, applications: Newton and Kepler laws (*Contact hours*: 4).*
2. *Finding Roots of Equations: Bisection method- Newton's method- fixed point method, Algebraic and transcendental equations, rearrangement of the equation (*Contact hours*: 8).*
3. *Interpolation: Polynomial interpolation, linear interpolation, quadratic interpolation, Lagrange interpolation, Newton difference method (*Contact hours*: 6).*
4. *The Method of Least Squares (Data Fitting): Linear least squares; non-linear least squares (*Contact hours*: 6).*
5. *Numerical Integration: One dimensional integral: Rectangle rule; Trapezium rule; Simpson's rule; Gaussian integration (*Contact hours*: 6).*

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6. ***Numerical Solution of Linear System (Matrix Algebra):*** *Simultaneous linear equations; Gaussian elimination; Pivoting, LU and cholesky (*Contact hours*: 6).*

7. ***Iterative Method:*** *Jacobi, Gauss–Seidel iteration; convergence and matrix norm, tridiagonal matrices (*Contact hours*: 6).*

8. ***Numerical Solution of Differential Equations:*** *Difference equations; Euler and Picard methods; Taylor series solutions; System of equations, Runge– Kutta methods, Higher-order equations (*Contact hours*: 8).*

9. ***Finite Differences Method for Ordinary Differential Equations*** *(*Contact hours*: 6).*

10. ***Introduction to PDEs:*** *First order linear PDEs -second order linear PDEs (*Contact hours*: 4).*

E. Office Hours

Office hours give students the opportinuity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm 1:** 6th or 7th week.
- **Midterm 2:** 11th or 12th week.
- **Quizzes & Homeworks:** During the semester.
- **Final Exam:** 16th week.

Your course grade will be based on your semester work as follows:

Midterm 1: 20 %	**Midterm 2:** 20 %	**Final Exam:** 40 %
Quizzes, Homework, Attendance & Participation: 20 %		

The grading distribution:

A+	A	B+	B	C+	C	D+	D	F
[95, 100]	[90, 95)	[85, 90)	[80, 85)	[75, 80)	[70, 75)	[65, 70)	[60, 65)	[0, 60)

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G. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

Executive Rules for Study Regulations and Exams
goo.gl/ykm7t3