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**	**4**	**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).*

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)

G. Student Workload

#	Teaching/Learning activities	Contact hours	Frequency	Total contact hours	Self-study hours	Total self-study hours	Student learning time
1	Lecture	2	15	30	1	15	45
2	Tutorial	2	15	30	1	15	45
3	Lab\practical	0	0	0	0	0	0
4	Homework	0	4	0	2	8	8
5	Quiz	0.5	2	1	1	2	3
6	Midterm	1.5	2	3	5	10	13
7	Final Exam	2	1	2	12	12	14
Total				**66**		**62**	**128**

The independent self-study is approximately 4 hours per week

H. 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