PHYS2601 — Introduction to Research

Course Description:
A study of the theoretical and practical application of some basic techniques used in research in the physical sciences. Emphasis is placed on an appreciation for the entire process of scientific practice from proposal throughexperimentation including poster and oral presentations, to writing a finalpaper. Includes computer modeling and simulations. (3 credits) *Prerequisites:* MAT1375, ENG1101 and one semester of a collegescience course

Required Text:
no textbook is required for this course

Instructional Objectives (Learning Outcomes):
This course is designed to give students an understanding of and the skills for preforming research in the real world. Learning how to construct experiments, analyze data and create reports students learn the basic skills of professional research. An understanding of statistical analysis, electromagnetic waves and the principles of quantum mechanics are also developed. In addition students learn to use a high level computer language to analyze dataand create figures.

Course-specific learning objectives include:

Upon completion of this course a student will be able to:

1. Understand how to plot data in linear, semi-log and log space and determine the correlation coefficient.
2. Be able to determine probabilities for simple games and understand how to compute probabilities using logical AND and OR.
3. Be able to explain the significance of a result in terms of standard deviation and the normal distribution.
4. Understand the principles of wave interference and differentiate between waves and particles.
5. Understand at an introductory level the fundamentals of quantum mechanics: de Broglie wavelength, the photoelectric effect, the Heisenberg Uncertainty Principle, the Bohr model of the atom, and wave functions.
6. Understand the shell model of the atom including the Pauli exclusion principle, quantum numbers and electron spin.
7. Understand the origin of the elements and the basic principles of strong interactions.
8. Understanding at an introductory level stars and their deaths, compact objects and the production of the elements.

9. Understand at a conceptual level the standard model of particle physics.

General education learning outcomes:

Upon completion of this course a student will be able to:

1. Discuss the scope of physics as a natural science, and practical applications of fundamental research to real world problems.
2. Describe the elements of the scientific method and its significance to scientific discoveries, the development of models, and the formulation of scientific theories.
3. Employ pictorial, graphical and mathematical methods to simplify and solve problems relevant to real-world applications.
4. Acquire and practice basic laboratory skills including gathering, analyzing and interpreting data.
5. Practice communication and writing skills in class discussions, preparation of written laboratory reports, and independent project work.
6. Practice collaborative work during laboratory activities.

Pathways learning outcomes:

Upon completion of this course a student will be able to:

1. Discuss the scope of physics as a natural science, and practical applications of fundamental research to real world problems.
2. Describe the elements of the scientific method and its significance to scientific discoveries, the development of models, and the formulation of scientific theories.
3. Employ pictorial, graphical and mathematical methods to simplify and solve problems relevant to real-world applications.
4. Acquire and practice basic laboratory skills including gathering, analyzing and interpreting data.
5. Practice communication and writing skills in class discussions, preparation of written laboratory reports, and independent project work.
6. Practice collaborative work during laboratory activities.

Assessment:

Students will be evaluated though laboratory reports, exams and a presentation. The final grade will be based on a weighted average of the grades from the reports, exams and presentation as follows:

Midterm	20%
Final Exam	20%
Lab Reports	40%
Presentation	20%

Course Outline

Lectures: 2 hours/week
Week 1: Introduction
Week 2: Modeling Data
Week 3: Introduction to Probability
Week 4: The Normal Distribution
Week 5: Introduction to Statistics
Week 6: Waves
Week 7: Midterm
Week 8: The Quantum Hypothesis
Week 9: The Uncertainty Principle
Week 10: The Bohr Model of the Atom
Week 11: The Quantum Mechanical Model of the Atom
Week 12: Electron Shell Structure
Week 13: Nuclear Physics
Week 14: The Standard Model of Particle Physics
Week 15: Final Exam

Laboratory work: 3 hours/week
Week 1: Introduction
Week 2: Graphical Measurement
Week 3: Harmonic Oscillators
Week 4: Double Slit Experiment
Week 5: How to use Matlab
Week 6: Michelson Interferometer
Week 7: Fabry-Perot Interferometer
Week 8: Polarization of Electro-Magnetic Waves
Week 9: Photoelectric Effect
Week 10: How to use Powerpoint
Week 11: Millikan Oil Drop
Week 12:The Charge of the Electron
Week 13: Atomic Spectra
Week 14: Spectroscopy of Supernova
Week 15: Final Presentation

Academic Integrity Policy Statement
Students and all others who work with information, ideas, texts, images, music, inventions, and other intellectual property owe their audience and sources accuracy and honesty in using, crediting, and citing sources. As a community of intellectual and professional workers, the College recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and at New York City College of Technology and is punishable by penalties, including failing grades, suspension, and expulsion.

College Policy on Absence/Lateness

A student may be absent without penalty for 10% of the number of scheduled class meetings during the semester as follows:

Class Meets	Allowable Absences
1 time/week	2 classes
2 times/week	3 classes
3 times/week	4 classes

Accessibility Statement

City Tech is committed to supporting the educational goals of enrolled students with disabilities in the areas of enrollment, academic advisement, tutoring, assistive technologies and testing accommodations. If you have or think you may have a disability, you may be eligible for reasonable accommodations or academic adjustments as provided under applicable federal, state and city laws. You may also request services for temporary conditions or medical issues under certain circumstances. If you have questions about your eligibility or would like to seek accommodation services or academic adjustments, please contact the Center for Student Accessibility by phone 718-260-5143, or online at http://www.citytech.cuny.edu/accessibility/ .

revised Nov. 2, 2010. Ariyeh Maller