PHYC 372 Introductory Mathematical Physics 2

Course Description

Techniques in the formulation and solution of physical problems. Computer algebra system (e.g. Mathematica) may be introduced for the study of topics such as boundary value problems, transforms, integral equations, and special functions of mathematical physics. (3 credit hours)

Prerequisite: PHYC 370, or permission of department chairperson.

Course Objective

To impart to the physics student:

An appreciation of the overall unity of the underlying mathematical methods in classical and modern physics.

Familiarity with frequently encountered mathematical methods, equations, functions, and solutions occurring in advanced physics courses.

Skill in the techniques of problem formulation and solution in mathematical physics.

Course Rationale

To familiarize the student with mathematical physics as a method for solving a great variety of problems in the physical sciences.

To illustrate the mathematical techniques with examples from theory and experiments in physics.

By providing an emphasis on practice in problem solving, the students will develop the experience and confidence to be able to apply the mathematical problem-solving techniques in a variety of applications.

Course Content, Format, and Bibliography

Content

Differential Equations

- Partial differential equations
- First-order differential equations
- Nonhomogeneous equations – Green's function

Boundary Value Problems, Sturm-Liouville Theory

- Self-adjoint differential equations
- Hermitian (self-adjoint) operators

- Gram-Schmidt orthogonalizations
- Completeness of eigenfunctions

Special Functions in Mathematical Physics

- Gamma function (factorial function)
- Bessel functions
- Legendre functions
- Fourier series

Transforms

- Integral transforms--introduction
- Fourier transforms
- Convolution theorem
- Laplace transforms
- Inverse Laplace transforms
- Other transforms sometimes confronted

Integral Equations

- Integral transforms, generating functions
- Neumann series, separable (degenerate kernels)
- Green's functions

Format

Lectures and problem solving.

This course is taught as a dual undergraduate/graduate course. Students will be required to complete activities appropriate for the level of the course in which they are enrolled. Student performance on homework, exams and/or labs will be evaluated using different standards for undergraduate and graduate students.

Bibliography

Arfken and Weber, *Mathematical Methods for Physicists*, 6th ed., Academic Press, ISBN 0-12-059876-0