PHYC 572 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, quiz, and exams will be evaluated using different standards for undergraduate and graduate students.

Extra assignments for graduate level counterpart of taught/with course:

Graduate students in taught/with course will be assigned one or more of the following, at the instructor's discretion, commensurate with the higher requirements of the graduate component as compared with the undergraduate component:

  Extra problem assignments
  Course term paper
  Individual experimental project
  Extra or different examination requirements
  Oral examination
  Class lecture on assigned topic
Assigned readings/report on the literature

Bibliography