PHYC 570 Introductory Mathematical Physics 1

Course Description
The application of mathematical techniques to the formulation and solution of physical problems, particularly those which occur in classical mechanics, thermodynamics, electromagnetic theory and quantum mechanics. Topics include computer algebra system and applications. (3 credit hours)

Prerequisite: PHYC 122 and 260 or permission of department chairperson.

Not open to the student who has credit in PHYC 370.

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
Vector analysis, with applications to mechanics and potential theory
   Review of vector algebra -vector mechanics
   Vector calculus
      Vector differentiation: gradient, divergence, curl, the del operator
      Vector integration: line, surface, volume integrals, Gauss's, Stokes's, Helmholtz' theorems; applications to mechanics and potential theory
Curved Coordinates and Tensors
Circular Cylindrical Coordinates
Spherical Polar Coordinates
Sensor Analysis and differential operators
Determinants and Matrices
  Determinants
  Determinant algebra
  Systems of linear equations; electrical circuit analysis by determinants
Matrice
  Orthogonal, hermitian, unitary matrices
  Diagonalization of matrices; the simple eigenvalue problem in physics
  Matrices in mechanics: the moment of inertia problem
Infinite Series
  Convergence tests – Uniform and absolute convergence
  Alternating series and Series of functions
  Taylor’s expansion – Binomial theorem
  Power series – Uniqueness theorem
Functions of a complex variable
  Review of complex algebra
  Cauchy-Riemann condition – analytic functions
  Cauchy’s theorem and formula
  Conformal mapping – basic properties and harmonic conjugates
  Calculus of residues and poles

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