# Master Syllabus Department of Physics and Astronomy



# **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

Arfken, Mathematical Methods for Physicists, 6th Ed., Academic Press, ISBN 0-12-059876-0

www.bsu.edu/physics