University of Arkansas – Fort Smith
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General Syllabus

PHYS 3303 Math Methods in Science II

Credit Hours: 3 Lecture Hours: 3 Laboratory Hours: 0

Prerequisite: PHYS 3203 Math Methods in Science I

Effective: 2018~2019

I. **Course Information**

  A. Catalog Description
  Continuation of Math Methods in Science I. Fourier series, calculus of variations, tensor analysis, special functions, and series solutions of differential equations, partial differential equations, and integral transforms will be used as problem solving tools.

  B. Additional Information
  This course is designed to introduce a broad range of mathematical techniques that are used to solve scientific problems. This course cannot achieve the depth of individual math courses on each subject and will not spend time on detailed proofs. The purpose is to give the student some experience with a variety of important mathematical techniques. We will emphasize on how the techniques can be used to solve various problems in the sciences.

II. **Student Learning Outcomes**

  A. Subject Matter
  Upon completion of this course, the student will be able to:

  1. Determine the maximum, minimum, points of inflection using basic calculus.
  2. Apply calculus of variations to specific problems.
  3. Derive and apply Euler-Lagrange equations.
  4. Evaluate a suitable coordinate system to simplify the work necessary to solve problems.
  5. Transform one coordinate system into another to aid in understanding and modeling the various problems.
  6. Identify and apply orthogonal transformations.
  7. Examine matrices to find and physically interpret eigenvalues and eigenvectors.
  8. Apply tensor analysis to solve complex problems.

9. Analyze various functions to aid in the amount of detail to be extracted from the solutions and will help visualize many problems.
10. Apply Laplace's, Poisson's, heat flow/diffusion, wave, and Helmholtz equations to many problems and understand the solutions.
11. Use complex numbers and the complex plane to explain and analyze real problems.
12. Determine and explain how complex variables are important through contour integration and mapping.
13. Do integral transforms.
14. Relate probability to many applications in science.

B. University Learning Outcomes
This course enhances student abilities in the following areas:

Analytical Skills
Critical Thinking Skills: Students will identify a problem or issue and will research, evaluate, and compare information from varying sources in order to evaluate authority, accuracy, recency, and bias relevant to the problems/issues. The student will generate solutions/analysis of problems/issues evaluated and will assess and justify the solutions and/or analysis.

Communication Skills (written and oral)
Students will communicate proficiently. The student will compose coherent documents appropriate to the intended audience and effectively communicate orally in a public setting.

Ethical Decision Making
Students will model ethical decision-making processes. The students will identify ethical dilemmas and affected parties and will apply ethical frameworks to resolve a variety of ethical dilemmas.

Global & Cultural Perspectives
Students will reflect upon cultural differences and their implications for interacting with people from cultures other than their own. The students will demonstrate understanding or application of their discipline in a global environment and will demonstrate how their discipline impacts or is impacted by different cultures.

III. Major Course Topics

A. Calculus of Variations
B. Special Functions
C. Series Solutions of Differential Equations;
D. Legendre, Bessel, Hermite, and Laguerre Functions
E. Partial Differential Equations
F. Functions of a Complex Variable
G. Probability and Statistics
H. Group Theory