Mathematical Methods for Physicists and Engineers.

Catalog Description: Mathematical techniques from the following areas: infinite series; integral transforming; applications of complex variables; vectors, matrices, and tensors; special functions; partial differential equations; Green's functions; perturbation theory; integral equations; calculus of variations; and groups and group representatives.

Hours: 3 hours (3 lecture/0 lab)

Prerequisites: MATH 2320 (Differential Equations) or Concurrent Registration

Campus Numberings:

Midwestern State University	PHYS 4301	Texas A&M University-Corpus Christi	PHYS 3490:304
Prairie View A&M University	PHYS 3163	Texas A&M University-Kingsville	PHYS 4303
Tarleton State University	PHYS 430	Texas Southern University	PHYS 247
Texas A&M University-Commerce	PHYS 317	West Texas A&M University	PHYS 4340

COURSE LEARNING OBJECTIVES:

Each successful student should be able to work problems at the junior/senior level taken from the following mathematical areas:	**Assessment Method:**
1. solutions to differential equations in both closed form and by using power series.	embedded course assessment
2. convergence of infinite series and transformation of series to other series or in closed form	embedded course assessment
3. techniques for evaluation of integrals including use of symmetry arguments, contour integration, and tabulated integrals	embedded course assessment
4. Integral transforms including Fourier series, Fourier transforms and Laplace transforms	embedded course assessment
5. Special Functions including Legendre, Bessel, Hypergeometric, Confluent Hypergeometric, Mathieu, and Elliptic	embedded course assessment
6. Integral equations including Classification, Degenerate Kernels, Neumann, and Fredholm Series, Schmidt Hilbert theory	embedded course assessment
7. Calculus of Variations	embedded course assessment
8. Linear algebra and matrix operations	embedded course assessment

Detailed Course Description (Course Topics): This course will spend approximate two weeks on each of seven or eight topics in mathematical physics.

The first topic is differential equations. A little of this chapter is a review for most students with sections added for power series solutions. The next topic is infinite series. We start this section discussing convergence of series. We look at how Bernoulli numbers are generated from working with series. We look at how to convert a series into a closed form or into a more useful series.

The third topic is how to evaluate integrals. We start by using basic calculus/algebraic operations to develop an integral from a known integral by doing operations on the constants in the known integral. We also introduce a few special functions that are defined by integrals. We also look at using symmetry arguments to determine some integrals. We cover enough theory of complex variables to develop contour integration.

The fourth topic is integral transforms. We start off developing and using Fourier series and then develop Fourier transforms. We develop Laplace transforms and mention other transform pairs. We look at applications of transforms

The fifth topic is the calculus of variations. We start by developing the Euler-Lagrange equation. We make several generalizations to the problem and look at the connection between the eigenvalue problem and the calculus of variations.

At the time of assigning the fifth topic students are also given a small list of problems. They are to choose one to do as a project. They are to be written up in a professional manner. These are involved

problems that require a significant amount of time to work and prepare. Students are given about one month to do their project problem.

The sixth topic is the solution to integral equations. We first classify integral equations and investigate solving ones with a degenerate kernel. We look at solving them with the Neumann and Fredholm series technique. We look at using Schmidt-Hilbert theory to solve certain integral equations. A few miscellaneous techniques are also discussed.

The seventh topic is special functions. We look at Legendre functions, Bessel functions, Hypergeometric functions, Confluent Hypergeometric functions, Mathieu functions, and elliptic functions. We look at these functions in light of what differential equations are satisfied by them, what integral equations are satisfies by them, and what special properties they posses.

The eighth topic is linear algebra and matrix operations including eigenvalue problems. Linear vector spaces and linear operators along with Matrix operations and characterization are discussed. Matrix diagonalization is developed. Infinite dimensional spaces are included.