E 117 Applied Mathematics for Engineers

Instructor: D.J. Steigmann

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Description: This course is about mastering the basic mathematical methods needed to solve equations that arise frequently in engineering and the physical sciences. The emphasis is very much on solution techniques, rather than theorems and proofs. Topics are motivated by specific examples arising in the fields of dynamics, solid mechanics, heat transfer and fluid mechanics.

Topics:

1. *Intro. to partial differential equations* (PDEs). We will 'jump right in' and introduce the topic through concrete examples. Introductory discussion of solution techniques. We will see how ordinary differential equations (ODEs) play an important role in the solution to PDEs.

2. *Methods for solving ordinary differential equations* (ODEs). Brief review of constant-coefficient equations and Euler's equation. Method of power series and Frobenius' method. Important examples.

3. *Method of separation of variables.* Application to problems in rectangular, cylindrical and spherical coordinates. Series expansions. Legendre polynomials and Bessel functions.

4. *Sturm-Liouville theory.* A general framework for treating variable-coefficient equations. Eigenfunction expansions and generalized Fourier series.

5. *Laplace transforms.* A powerful technique for solving initial-value problems (ODEs and PDEs with assigned initial conditions).

6. *Fourier transforms.* Review of conventional Fourier series and its use in deriving the Fourier transform, a powerful method for solving ODEs and PDEs on 'unbounded' domains.

7. *Intro. to finite difference methods.* A basic introduction to some elementary numerical methods for solving ODEs and PDEs.

8. *Special topics* (time permitting).

Pre-requisites: Math 53 and Math 54, or their equivalents.

Text:

E. Kreyszig, Advanced Engineering Mathematics, Wiley.

Grading: Homework (10%), Two Midterms (25% each) and a Final (40%).

Homework policy: Homework will be assigned and collected on a regular basis. Late homeworks *will not be accepted.* Solutions will be posted one day after the due date. Do the homework! It is the best way to learn the material and prepare for exams. *A record of consistently turning in* **complete** *homework assignments* **on time** *will count in your favor* if your course grade is borderline between two letter grades.