

## MME 532 Differential Equations (2 CR)

Winter 2017

last updated January 2

This course has concepts and techniques for both Ordinary and Partial Differential Equations. Topics from ordinary differential equations include existence and uniqueness for first order, single variable problems as well as separation of variables and linear methods for first order problems. Second order, linear equations will be solved for both the homogeneous and non homogeneous cases. The phenomena of beats and resonance would be analyzed. The Laplace Transform are introduced for appropriate second order nonhomogeneous problems. Partial Differential Equations focus on boundary value problems arising from the Heat and Wave equations in one variable. Fourier Series expansions are used to satisfy initial conditions and the concepts of orthogonality and convergence addressed.

Recurring theme: talk and think about secondary math courses and how they provide a foundation for subsequent work in Differential Equations. Key topics, important concepts, good habits. Connection of AP Calculus to subsequent work in Differential Equations. Significance of PreCalculus areas (logs/exp, trig, basic algebra).

**textbook:** *Differential Equations and Their Applications* - - Stanley Farlow - - Dover

other resources: any decent Calculus textbook

on line review videos (see Canvas module)

Maple or another symbolic package

schedule: 14 meetings. No class during public school vacations.

### Syllabus

1. Classification, Motivation (1/2 class)
  - Classification – ordinary vs partial, linear vs nonlinear, IC, BVP
  - First order existence-uniqueness considerations
  - Some classic differential equations and problems

#### Ordinary Differential Equations

2. Review of Integration (1/2 class)
  - FTC, techniques
3. First Order (1-2 classes)
  - Separation of variables
  - Partial fractions
  - Existence-uniqueness considerations

Numerical option – Cauchy Euler  
geometric issues

**Quiz #1**

4. Second Order Linear (3-4 classes)
  - Homogeneous, constant coefficient
  - Review: complex #s, Euler's Equation (trig one)
  - Damped oscillations
  - Forced systems
  - Undetermined Coefficients
  - Trig Identities via Euler
  - Beats
  - Resonance
  - Transient and steady state considerations

**Quiz #2**

5. Laplace Transforms (2 classes)

**Partial Differential Equations**

review: partial differentiation

6. Separation of Variables (1 class)
7. Heat Equation – 1 dimension (1 -2 class)

**Quiz #3**
8. Fourier Series (1-2 classes)
  - Orthogonality
  - Expansions
    - Even/odd
  - Rate of convergence and smoothness of function
  - Visual tools available
9. Wave Equation – 1 dimensional (1-2 class)
  - Homogeneous BC
  - Standing waves; superposition and vector spaces
  - Harmonics
10. Sturm-Liouville (time, interest, ability permitting)
  - More general orthogonality considerations –

**Quiz #4**

Grade:

4 quizzes – 40% 45 minutes

**homework** - - 60% . Due at the start of class each week.

What you turn in should be neat, stapled together, no ragged pages torn out of binder. Steps leading to answer clearly shown. If you can't do a problem, you can't do it. Not the end of the world. Move on.

Any outside resources used at any time should be referenced. Representing the work of another as your own is plagiarism and is unacceptable (see WPI statement on academic honesty at the link

<https://www.wpi.edu/about/policies/academic-integrity/dishonesty> )

General expectations of students: as you encounter places where you have gaps in your background or memory, *do what it takes to fill those in*, as needed. This can vary considerably from person to person.