

## COURSE SYLLABUS

Course: Differential Equations  
Number: Math 373  
Units: 4 Credits

Course Description: A first course in differential equations. Topics generally include separable, homogenous, exact, and linear first order differential equations; integrating factors, higher order linear differential equations, variation of parameters, differential operators, the Laplace transform, inverse transforms, systems of differential equations, power series solutions, Fourier series, and applications.

Prerequisites: MATH 166 (Calculus II) or equivalent. [First year Calculus - Differential and Integral Calculus, Series/Approximation]

Detailed Syllabus:

### 0. Getting Started

1. Email and Chat
2. Learning About the Course
3. Fundamentals of Mathematica

### 1. Exponential Differential Equations

1. Unforced
2. Forced
3. Steady State
4. Personal Finance
5. Step Function and Dirac Delta Function
6. Tangent Vectors
7. Initial Conditions

### 2. Second-Order Differential Equations

1. Overdamped and Underdamped Oscillators
2. Linear Forced and Unforced Oscillators
3. Homogeneous Equations
4. Inhomogeneous Equations
5. Characteristic Equations
6. Euler's Formula
7. Impulse Forcing
8. Dirac Delta Convolutions
9. Springs and Electrical Charges
10. Higher Order Equations

3. Laplace Transforms
  1. Laplace Transforms of First and Second Order Equations
  2. Fourier Analysis and Fits
  
4. Graphical Analysis of Differential Equations
  1. Euler's Method
  2. Flow Plots and Trajectories
  3. Predator-Prey Model
  4. Logistic Harvesting
  
5. First-Order Differential Equations
  1. Autonomous Equations
  2. Non-Autonomous Equations
  3. Separation of Variables Solving Method
  4. Bifurcation Points
  
6. Systems of Differential Equations
  1. Flows and Trajectories
  2. Conversion Between Higher Order ODEs and Systems
  3. Damped and Undamped Oscillators
  
7. Matrix Applications
  1. Conversion to Matrices
  2. Eigenvalues and Eigenvectors
  3. Applications to Life Sciences and Physics
  
8. Linearization
  1. Approximating Non-Linear DEs via Linearization
  2. Lyapunov's Rules
  3. Pendulums
  4. Van der Pol Oscillator
  5. Chaos
  6. Hamiltonian Systems

