Differential Equations (Summer 2019)

This is the official website of math324-01-su19.[1)]

THIS PAGE IS NO LONGER UPDATED

General Information

The syllabus is posted, and you should definitely read it; here is some of the content for quick reference.

Meetings

Every Weekday 9:50am - 11:50am in SL 210

Office Hours

By Appointment in WH310

Textbook

A First Course in Differential Equations with Modeling Applications (11e) by Zill

Grading

See the course syllabus for a grade distribution.

Content

Basic techniques and theory in solving simple ordinary differential equations, initial value problems, and boundary value problems. Time permitting we will also cover numerical methods for approximating solutions and some real-world applications of our methods in various disciplines.

Learning Tools

This course uses the following free learning tools for students.

- Khan Academy is useful for videos and practice problems. I will assign videos from time to time; join our class by following the link I sent to our email listserv.
- Paul's Online Notes are fairly good; be warned that they don't match our class perfectly.

- GeoGebra is a freely available computer algebra system; it will open all files below with the .ggb extension. I write GeoGebra sheets using GeoGebra Classic 6.
- GNU Octave is an open source version of MatLab and is mostly compatible with the MatLab commands. I use Octave for numerical methods.

Schedule

28 May 2019 T

- Discussed the syllabus
- Introduction to ODEs
  - Terminology
  - Verifying solutions
- Homework 1 (Mostly Calculus 1 review in our new language…)

29 May 2019 W

- Went over two homework problems (with brief Calculus 1 review)
- Brief review of partial derivatives (in an)
- Initial Value Problems
  - A theorem on existence and uniqueness of solutions to first-order IVPs
  - An example from Calculus 1
- Visualizing First-Order Equations
  - Direction fields (very brief discussion)
- Homework 2

30 May 2019 R

- Direction fields (for first-order ODEs)
  - An example on the board
  - Several examples (including approximated solutions) in this GeoGebra sheet
    - *NB*: Mine is a slightly modified version of this GeoGebra sheet
- Separable First-Order Equations
  - Solved several separable ODEs
  - Developed the Separation of Variables method
- Homework 3 (use graph paper for the first problem)

31 May 2019 F

- Exact First-Order Equations (assigned Khan Academy videos)
  - Exactness Criterion
  - Solving an exact equation
  - Using integrating factors to transform nonexact ODEs into exact ODEs
- Linear First-Order Equations
  - *Case 1*: Separable

    - *Case 2*: Simple integrating factor
- Solutions by Substitutions
    - Bernoulli's Equation
- *NB*: I've assigned two Khan Academy videos on homogeneous equations (relevant for problem 7 below).
- Homework 4 (long, but you have the weekend...)

3 June 2019 M

- Solutions by Substitutions
    - Homogeneous First-Order Equations (assigned Khan Academy videos)
- Review for Midterm 1 (student questions)
- Written Assignment 1 (Due at Midterm 1)

4 June 2019 T (MIDTERM 1)

- Midterm 1 Administered
- Collected Written Assignment 1
- Applications
    - Linear Models
        - Bacterial Growth
        - Radioactive Decay
        - Newton's Law of Cooling
        - Kirchoff's Current Law

5 June 2019 W

- Returned Midterm 1
- Higher-Order Linear Equations
    - Homogeneous Linear Equations
        - Superposition Principle (i.e. linear combinations of solutions are solutions)
        - Linear Independence and the Wronskian
        - Fundamental Sets of Solutions
        - The General Solutions Theorem
    - Nonhomogeneous Equations
        - The General Solutions Theorem
- *NB*: Gave lots of motivation from linear algebra to make the theorems plausible; linear algebra will not be tested.
- Homework 5

6 June 2019 R

- Derived Euler's Formula via Maclaurin Series
- Brief Review of General Solutions to Linear Equations
- Solving Homogeneous Linear Equations with Constant Coefficients
    - Using Auxiliary Equation
        - *Case 1*: Distinct real roots
        - *Case 2*: Complex roots
        - *Case 3*: Repeated roots

- Reduction of Order
  - Brief Introduction
- Homework 6

7 June 2019 F

- Reduction of Order
  - Second-order examples
- Method of Undetermined Coefficients (via Differential Operators)
  - Factoring differential operators
  - Constructing operators for given functions
  - Using differential operators to find particular solutions
- *NB*: See Paul's Online Notes for an alternative “guess-and-check”-type approach–that method can fail spectacularly (e.g. when the guess is a solution of the associated homogeneous ODE)…
- Homework 7 (long, but you have the weekend…)

10 June 2019 M

- More on the Method of Undetermined Coefficients
  - Another example
- Variation of Parameters
  - Idea of method (partial derivation)
  - Several second-order examples
  - Third-order example
- Cauchy-Euler Equations
  - Brief introduction to auxiliary equation
- Homework 8

11 June 2019 T

- Cauchy-Euler Equations
  - Reduction to constant coefficients case
- Review for Midterm 2 (student questions)
- Written Assignment 2 (Due at Midterm 2)

12 June 2019 W (MIDTERM 2)

- Midterm 2 Administered
- Collected Written Assignment 2
- Review of Power Series
  - Definitions of Interval and Radius of Convergence
  - Basic Properties of Power Series
  - Table of Useful Maclaurin Series

13 June 2019 R

- Power Series Operations
- Power Series Methods in ODEs
  - Solved Three ODEs via Power Series
- Homework 9

14 June 2019 F

- Quiz
  - Went over quiz problem together
- Ordinary Points and Singular Points
  - Definitions and brief discussion of differences
- Homework 10

17 June 2019 M

- Series Solutions near Singular Points
  - Frobenius Method
  - Several Examples
- Homework 11

18 June 2019 T

- Numerical Methods
  - Power Series Approximations
  - Euler's Method
  - Improved Euler's Method
  - Runge-Kutta Methods
- Homework 12

19 June 2019 W

- Review for Midterm 3 (student questions)

20 June 2019 R (MIDTERM 3)

- Midterm 3 Administered
- Laplace Transforms
  - Definition
  - Three Examples

21 June 2019 F

- Laplace Transforms
  - Basic Properties of Laplace Transforms
  - Many Examples

  - The Inverse Laplace Transform
- Homework 13

24 June 2019 M

- Solving ODEs with Laplace Transforms
  - Two IVPs
  - Group Quiz
- Homework 14

25 June 2019 T

- Linear Systems of ODEs
  - Laplace Transforms to Solve Linear ODE Systems
  - Annihilator Technique to Solve Linear ODE Systems
- Homework 15

26 June 2019 W

- Review for Final (student questions)

27 June 2019 R

- Review for Final (student questions)

28 June 2019 F (FINAL)

- Final Administered

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[1] If you have an idea to improve this space, please email eppolito-at-math-dot-binghamton-dot-edu with your suggestion; I would like this space to be as useful to students as possible…

From:
https://www2.math.binghamton.edu/ - **Department of Mathematics and Statistics, Binghamton University**

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