

ORDINARY DIFFERENTIAL EQUATIONS HOMEWORK

- This homework is based on: D.G. Zill (2013): “A first course in differential equations”, 10th edition, Brooks/Cole, Cengage Learning (textbook)
- Problems indicated “for fun” are for math majors, for some extra challenge.
- Homework will be assigned, but will not be collected or graded. Nevertheless, it is crucial to do the homework as part of your preparation for the exams. To keep up, I recommend that **after every lecture you should solve the homework problems corresponding to the material covered on that day’s lecture. Thus you need to work on a continuous basis!** Maintain a well-organized written record of your homework solutions by **writing the statement of each problem** (so that your document is stand-alone and can be read by itself), followed by your detailed solution, and clearly indicate the problem, section, and chapter number of the question. Most homework problems require more than simply writing the answer, and so you must write all steps of your solution and provide appropriate justification, as illustrated by the instructor’s solved examples, as you would on a test or quiz. Write neatly and legibly, using rigorous mathematical notation. While you are encouraged to discuss homework problems with other students, tutors, your instructor, and other faculty, the write-up of your solutions must be your own work and not simply copied from another student or another source. Use a ring binder to collect your homework, and write with a black pen, as that will help you to later scan the ring binder as a PDF file, for possible future use, and as a form of backup. This will provide you with a readily available resource to prepare for tests and quizzes, as well as providing documentation of the homework problems should you have a question about a problem and seek help from the instructor or a tutor.

Introduction to Differential Equations

Read lecture notes and §1.1, §1.2, §1.3
§1.1: 1-18

First-order ODEs

- **Separable ODEs**

Read §2.2
§2.2: 1-10, 16, 17, 21, 23-28
§2.2: 45-50 (for fun)

- **Homogeneous ODEs**

Read lecture notes
§2.5: 7,8,11,12, 13

- **Integrating Factors Method**

Read §2.3
§2.3: 4-14, 17-24, 25-36

- **Exact ODEs**

Read §2.4

§2.4: 1,3,5,9,13,15,19,21,23,25

- **Integrating factors for exact ODEs**

Read §2.4

§2.4: 27,28,29-32,35,36,37,38

- **Exact-like ODE with self-similar $M(x, y)$ and $N(x, y)$**

Read §2.5

§2.5: 1-6,9,10,11-14

- **Bernoulli equation**

Read §2.5

§2.5: 15-22

- **ODEs solved by linear substitution**

Read §2.5

§2.5: 23-30

§2.5: 31 (for fun)

Linear Algebra Review

Read lecture notes
 Read Appendix II
 §II.1: 1,5,6
 §II.2: 31, 35, 37 (use Cramer rule)

Linear Differential Equations

- **Basic definitions – terminology**
 Read Lecture notes
- **Function spaces and linear equations**
 Read Lecture notes
- **Homogeneous linear differential equations – solution set of the homogeneous ODE**
 Read Lecture notes
 Read §4.1
 §4.1: 38, 40
 §4.1: 41 (for fun)
 ODE4: 1
- **Homogeneous linear differential equations – the initial value problem**
 Read Lecture notes
 ODE4: 2, 3 (for fun), 4,5
 §4.1: 23-30 (hint: show the proposed solutions solve the ODE and establish linear independence to confirm you got all of them)
- **Solving homogeneous linear differential equations – 1. Constant coefficient case**
 Read §4.3 and lecture notes
 §4.3: 29-36

ODE4: 6,7,8

- **Solving homogeneous linear differential equations – 2. Equidimensional case**
 Read §4.7
 §4.7: 25-28
 ODE4: 9,10,11,12
- **Solving inhomogeneous linear differential equation**
 Read §4.6, §4.8.1
 §4.6: 19-22
 §4.8.1: 1,3,6, 19, 22, 24-30
 ODE4: 13,14
 ODE4: 15 (for fun)

Generalized functions

- **Schwarz definition of generalized functions**
 Read Lecture notes
- **Dirac delta functions**
 Read Lecture notes
 Also look at §7.5
 ODE5: 1,2,3,4
- **Derivative of distributions**
 Read Lecture notes
 ODE5; 4,5,6,7
- **Heaviside distribution and degrees of singularity**
 Read Lecture notes
 ODE5: 8,9
- **Distributions and Greens functions**
 Read Lecture notes
 ODE5: 10, 11, 12

...to be continued