Math 334: Ordinary Differential Equations

Fall 2021

(Section 2 & 3)

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Office Hours:

- Monday, Wednesday 1 - 2 PM, Friday 1:30 - 3 PM at 265 TMCB (in person)
- Tuesday 1:30 - 3 PM on Zoom. Link: https://byu.zoom.us/j/4429506864?pwd=bXAwWUVIWFlzSzdzdVVMSG9QTHYxdz09

Course Credits: 3
Time and Location:

- Section 2: 11:00 - 11:50 AM on MWF at JKB 3104.
- Section 3: 12:00 - 12:50 PM on MWF at JKB 3104.

Couse website:
http://math.byu.edu/~tpham/Courses/F21-Math-334/F21-Math-334.html
Learning Suite:
https://learningsuite.byu.edu/.29AZ/cid-toAMCIKVg1j4/home
Textbook: "*Elementary Differential Equations*", 11th Edition, by Boyce, Diprima and Meade.
Note: There is another version of the book with title "Elementary Differential Equations and Boundary Value Problems" by the same authors. This textbook is the same as the previous one, except that it has two more chapters (10 and 11). Because we will only cover Chapters 1-7, either textbook will work for this course.

Other Learning Resources:

1. Math Lab is open for online and in-person service. You can ask questions or request tutoring there: https://math.byu.edu/?page_id=193.

2. From time to time, we will use a mathematical software called Mathematica to visualization purposes. You can also use it to double check your answers in homework problems. Learning Mathematica is encouraged in this course, although not mandatory. You can earn extra points in homework sets by doing the "M" problems using Mathematica. The instruction to install Mathematica will be given on Page 4 of this syllabus.

Course Description: Students will be introduced to differential equations and basic methods to solve them. Many of these equations come from physics, mechanics, biology, chemistry, and economics; for example, the mass-spring motion, electrical circuits, population growth, heat transfer, carbon dating, and interest rates. Although not all differential equations can be solved "explicitly", students will learn methods to analyze the problem and interpret/visualize the solutions (if can be solved). An understanding of a differential equation leads to an better understanding of the phenomenon it describes. This course is suitable for all those interested in science, engineering, or economics. The prerequisites are Math 113 and Math 213 (formerly 313).

Learning Outcomes: Upon completion, a successful student will be able to:

1. Write mathematical models of certain phenomena such as mass-spring motion, heat transfer, radiation time, and so on.
2. Know how to solve linear differential equations (or simple systems of linear differential equations) with constant coefficients. These methods include the Laplace transform, power series, variation of parameters and method of undetermined parameters.
3. Identify certain behaviors of solutions, for example asymptotic approximations, boundedness, and stability of the solutions under slight variation of the input parameters.
4. Use Mathematica to solve differential equations and visualize the direction fields, phase lines, phase planes, and the solutions.

Grading:
Homework: 25% (plus 2% bonus if you use Mathematica for the "M" problems)
Chapter reviews: 4% (optional)
Midterm 1: 25%
Midterm 2: 25%
Final Exam: 25%

Homework: due at 11:59 PM on Learning Suite on Tuesdays and Fridays. A schedule of written homework assignments was posted on the course website and Learning Suite.
Policy: Homework is to be submitted on Learning Suite. Typing would be great, but not required. You are encouraged to work together, but should write your homework in your own words and reflect your own understanding.

Each homework set is worth 15 points. The lowest two scores will be dropped. Only a few selected problems will be graded in detail. The rest will be given credit based on completion. Some homework sets have "M" problems. You can earn up to 2 bonus points in those homework sets if you include commands and graphs from Mathematica in the "M" problems. Make sure that graphs are accompanied by commands (codes) as an evidence that you did use Mathematica. You can simply take a screenshot of your computer screen. See an example on Page 6 of the syllabus. If you don't use Mathematica, you can still earn full credit of the homework set, but not the bonus points.
Requirements for written work: you should write coherently in complete sentences, with attention to the audience.

Chapter reviews: there will be optional review problems for each chapter given on Learning Suite as multiple choice questions. Doing these problems not only helps you earn extra credits but also is a meaningful way to prepare for the exams.
Policy: these assignments are given in the format of "exams" on Learning Suite. There are no constraints on time (except for the due dates) and you can save your work, exit the exam, and submit later. You are allowed to submit each assignment set twice.

Midterm Exam: there will be two midterm exams, 2 hours long each, taken at BYU's Testing Center.

- Midterm 1: Oct 6 – 8 (late fee of $5 if taken after 2 PM on Oct 8)
- Midterm 2: Nov 10 – 12 (late fee of $5 if taken after 2 PM on Nov 12)

Policy: You can use a pocket calculator, but are not allowed to bring notes.

Final exam:

- Section 2: 11 AM - 2 PM on Thursday 12/16/2021 at JKB 3104.
- Section 3: 11 AM - 2 PM on Tuesday 12/14/2021 at JKB 3104.

Policy: Final exam only covers the material after the second midterm. You can use a pocket calculator, but are not allowed to bring notes.

Make-up work: If you experience extended illness, injury, hospitalization, or other major disruption during the semester and cannot complete your work, please speak to your instructor. Special accommodations may be able to be arranged on a case by case basis.

COVID-19 policy: The university has asked all students and teachers to wear a mask in classroom when 6-feet distance from others cannot be maintained. If you are in quarantine, please inform the instructor, who will then give you a code to control the classroom camera remotely, so that you can attend the class virtually through Zoom. Lecture proceedings will not be recorded unless there is a request from one of the students. If you choose not to attend classes in person only because you prefer not to wear a mask, it is

the university's policy that the instructor needs not provide accommodations.

Grade lines: the course grade lines will not be harder than the standard grade lines: A 100-93%, A- 92.99-90%, B+ 89.99-87%, B 86.99-83%, B- 82.99-80%, C+ 79.99 - 77%, C 76.99-73%, C- 72.99-70%, D+ 69.99-67%, D 66.99-63%, D- 62.99 - 60% and E $<$ 60%.

Preventing Sexual Harassment: Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds. The act is intended to eliminate sex discrimination in education and pertains to admissions, academic and athletic programs, and university-sponsored activities. Title IX also prohibits sexual harassment of students by university employees, other students, and visitors to campus. If you encounter sexual harassment or gender-based discrimination, please talk to your professor; contact the Equal Employment Office at 801-422-5895 or 1-888-238-1062 (24-hours), or http://www.ethicspoint.com; or contact the Honor Code office at 801-422-2847.

Students with Disabilities: BYU is committed to providing reasonable accommodation to qualified persons with disabilities. If you have any disability that may adversely affect your success in this course, please contact the University Accessibility Center at 422-2767. Services deemed appropriate will be coordinated with the student and instructor by that office.

Get access to Mathematica

There are two methods to get access to Mathematica.

Method 1: (cloud based, no installation required)

- Go to https://byuapps.cloud.com/
- Sign in with your Net ID. Make sure to include '@byu.edu' at the end.
- On the left panel, click on Apps, then All Apps. Scroll down to locate Wolfram Mathematica.

Method 2: (installation on your own computer)

- Go to https://software.byu.edu/mathematica
- Click on platform (Window or Mac) that is compatible with your computer. The download will start.
- Meanwhile, click on the link 'Product Key'. It will takes you to the Sign-in/ Sign-up page. Create a Wolfram Alpha account if you haven't had one. Make sure to use your NetId@byu.edu email to sign up.
- Check your BYU email. You should receive an activation code from Wolfram Customer Support.

Example of an "M" problem

Problem 2, Section 1.2:

a) $\frac{dy}{dt} = y - 5$, $y(0) = y_0$

$\rightsquigarrow \frac{dy}{y-5} = dt$

Integrate both sides:

$\ln|y-5| = t + C \rightsquigarrow |y-5| = e^{t+C} \longrightarrow y = 5 \pm e^{t+C} = 5 + ke^t$

Plug $t = 0$: $\underbrace{y(0)}_{y_0} = 5 + ke^0 = 5 + k$

Thus, $k = y_0 - 5$. Conclusion: $\boxed{y = 5 + (y_0 - 5)e^t}$ (see graph below)

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In[1]:= y0 = 1;
        Plot[5 + (y0 - 5) * Exp[t], {t, -1, 1}]
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Out[2]=