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**ChE 132A: Analytical Methods in Chemical Engineering**  
**Spring 2026**

<b>Homework 1</b> Exercises 1, 2, and 3 in the math background handout.	<b>Due: Friday, April 10</b>
<b>Homework 2</b> Exercises 1, 3, 5, and 6 in the ODEs handout.	<b>Due: Friday, April 17</b>
<b>Homework 3</b> Exercises 1, 2, and 3 in the Laplace transform handout.	<b>Due: Friday, April 24</b>
<b>Homework 4</b> Exercises 6, 7, and 16 in the Laplace transform handout.	<b>Due: Friday, May 1</b>
<b>Midterm</b> (in class)	<b>Tuesday, May 5</b>
<b>Homework 5</b> Exercises 1, 3, and 8 in the Fourier analysis handout.	<b>Due: Friday, May 15</b>
<b>Homework 6</b> Exercises 5, 11, and 12 in the Fourier analysis handout.	<b>Due: Friday, May 22</b>
<b>Homework 7</b> Exercises 1, 2, 3, and 4 in the PDEs handout.	<b>Due: Friday, May 29</b>
<b>Homework 8</b> Exercises 8, 9, and 11 in the PDEs handout.	<b>Due: Friday, June 5</b>

**See next page for Gradescope instructions**

**Q1 Exercise1**  
40 Points

Trigonometric and hyperbolic functions and their zeros

1

**Exercise 1 (Trigonometric and hyperbolic functions and their zeros).**

- (a) Make a plot of  $\cosh x$  and  $\sinh x$  for real-valued  $x$ .
- (b) Using Euler's formula, derive the two relationships stated in the handout valid for all complex-valued  $z$

$$\cosh iz = \cos z \quad \sinh iz = i \sin z$$

- (c) In the complex plane, sketch the locations that you already know for the zeros of  $\sin z$  and  $\cos z$ . Note that the real zeros that you know are *all* the zeros in the complex plane.
- (d) Using your derived relationship between the trigonometric and hyperbolic function, sketch the locations of all the zeros of  $\cosh z$  and  $\sinh z$ . So now you know that the hyperbolic functions also have infinitely many zeros, but we have to consider the complex plane to locate them.
- (e) Bonus question. So what about the exponential itself, which we are using to build the trigonometric and hyperbolic functions. Does  $e^z$  have zeros in the complex plane?

**Q1.1**  
0 Points

2

Please upload your work for Exercise 1 in a single PDF here:

 Please select file(s)

**Q1.2 a: Make a plot of  $\cosh x$  and  $\sinh x$  for real-valued  $x$**   
8 Points

3

- a:  $\cosh(0) = 0$  and  $\sinh(0) = 1$
- b:  $\cosh(0) = 1$  and  $\sinh(0) = 0$
- c:  $\cosh(0) = e$  and  $\sinh(0) = e$
- d:  $\cosh(0) = 1/2$  and  $\sinh(0) = 1/2$

### Instructions for homework submission:

1. Read the exercise carefully and solve all parts of the exercise by hand, either on paper or using a tablet.
2. Take clear photos of your handwritten solutions, ensuring that all work is legible, and upload a single PDF file to Gradescope for that exercise.
3. Choose the appropriate multiple-choice answers for each part of the question on Gradescope.

Repeat these steps for each exercise in the homework set, uploading one PDF file per exercise at the appropriate location on Gradescope.<sup>1</sup>

Failure to submit a handwritten solution will result in a zero score for that question, even if the correct multiple-choice answers are selected.

<sup>1</sup>Do **not** upload one PDF file for the entire homework set, but one PDF file per exercise.