

AMA2111 Mathematics I

2025-26 Semester 1 Homework 2

Due Date: Sun, 23 Nov 2025, 17:00

- Put the following information on the top right corner of the front page of your homework.
 - Your name and student number
 - Subject code: AMA2111
 - Subject lecturer: Dr. LOU Yijun
- You should finish all questions.
- Photograph your solutions onto a PDF file named YourName_StuID, otherwise the marker (not the lecturer) cannot write on your solution, then you cannot see the marking but only the score.
- You may use the app “CamScanner” or other softwares. Make sure that the file is complete, legible, in correct order and orientation.
- Upload/attach your homework solution pdf file at the same place you’ve downloaded this homework by pressing the “Browse My Computer”, then choose your pdf file, and then press Submit. You may re-submit the homework again, to a maximum of twice, before the due time. After submitting, check and make sure your submission is successful.
- No late submission is allowed. It may not be marked.

1. Solve the initial value problem

$$\mathbf{y}' = \begin{bmatrix} 4 & 2 & 2 \\ 2 & 4 & 2 \\ 2 & 2 & 4 \end{bmatrix} \mathbf{y}, \quad \mathbf{y}(0) = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}.$$

2. Find the general solution of

$$y'' + 2y' + 2y = 6 \cos x$$

by method of undetermined coefficients.

3. Solve the initial value problem

$$y'' - y' - 2y = 3 + 5e^{2x}, \quad y(0) = 0, \quad y'(0) = 1$$

by method of undetermined coefficients.

4. Find the general solution of

$$y'' - 2y' + y = \frac{e^x}{x}$$

5. Solve the initial value problem

$$y'' + y = 2x \sin x, \quad y(0) = 0, \quad y'(0) = 1$$

by variation of parameters.

6. Use the Laplace transform to solve the initial value problem

$$y'' + 4y = 8 \sin 2t, \quad y(0) = 0, \quad y'(0) = 1.$$

7. Use Laplace transforms to solve the initial value problem

$$y'' + 4y = f(t) = \begin{cases} t, & 0 \leq t < 2, \\ 4, & t \geq 2, \end{cases} \quad y(0) = 0, \quad y'(0) = 0.$$

8. Let f be a differentiable function of one variable, and $w = f(x^2 + 3xy)$.

- (a) Verify that the function w satisfies the equation $3xw_x - (2x + 3y)w_y = 0$.
- (b) If $f(u) = e^u$, calculate w_{xy} .

9. Let $w = f(x, y)$ be a function satisfying $\ln w + w = xy^2$, and $f(1, 1) = 1$.

- (a) Find the partial derivatives $w_x(x, y)$, $w_y(x, y)$, and $w_{xy}(x, y)$.
- (b) Use linear approximation to estimate $f(1.05, 0.95)$.