UCLA Math 33B − Practice Problems

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A list of practice problems for UCLA Math 33B. Solutions are provided in a separate document on my webpage. Please feel free to email me if you there is a topic you would like me to add to this list.

1. Solve $(t^2 + 1)dy = e^{-y}dt$, $y(0) = 0$.

2. Solve $y' + 3y = t^2$, $y(0) = 1$.

3. Solve $\left(2t - \dfrac{t}{t^2 + 1} + \cos(y^2)\right) dt + (3 - 2ty\sin(y^2))\, dy = 0$.

4. Solve $2y'' + y' - 3y = 0, y(0) = 3, y'(0) = -2$.

5. Solve $y'' + 6y' + 9y = 0, y(0) = 3, y'(0) = -10$.

6. Solve $y'' + 4y' + 13y = 0, y(0) = -1, y'(0) = 14$.

7. Solve $y'' - y' - 2y = t + \sin t$, $y(0) = \dfrac{47}{20}$, $y'(0) = \dfrac{1}{5}$.

8. Solve $y'' - 10y' + 25y = e^{5t}$, $y(0) = 2$, $y'(0) = 9$.

9. (a) Find the general solution to the system $\mathbf{x}' = \begin{pmatrix} -5 & -7 \\ -14 & 2 \end{pmatrix} \mathbf{x}$.

   (b) Determine the stability of the system.

   (c) Classify the system and sketch the phase portrait of the system.

   (d) Solve $\mathbf{x}' = \begin{pmatrix} -5 & -7 \\ -14 & 2 \end{pmatrix} \mathbf{x}$, $\mathbf{x}(0) = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$. What is $\lim_{t\to\infty} \mathbf{x}(t)$?

10. (a) Find the general solution to the system $\mathbf{x}' = \begin{pmatrix} -5 & 0 \\ 0 & -5 \end{pmatrix} \mathbf{x}$.

    (b) Determine the stability of the system.

    (c) Classify the system and sketch the phase portrait of the system.

    (d) Solve $\mathbf{x}' = \begin{pmatrix} -5 & 0 \\ 0 & -5 \end{pmatrix} \mathbf{x}$, $\mathbf{x}(0) = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$. What is $\lim_{t\to\infty} \mathbf{x}(t)$?

11. (a) Find the general solution to the system $\mathbf{x}' = \begin{pmatrix} 2 & -1 \\ 0 & 2 \end{pmatrix} \mathbf{x}$.

    (b) Determine the stability of the system.

(c) Classify the system and sketch the phase portrait of the system.

(d) Solve $\mathbf{x}' = \begin{pmatrix} 2 & -1 \\ 0 & 2 \end{pmatrix} \mathbf{x}$, $\mathbf{x}(0) = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$. What is $\lim_{t \to \infty} \mathbf{x}(t)$?

12. (a) Find the general solution to the system $\mathbf{x}' = \begin{pmatrix} -5 & 10 \\ -2 & 3 \end{pmatrix} \mathbf{x}$.

(b) Determine the stability of the system.

(c) Classify the system and sketch the phase portrait of the system.

(d) Solve $\mathbf{x}' = \begin{pmatrix} -5 & 10 \\ -2 & 3 \end{pmatrix} \mathbf{x}$, $\mathbf{x}(0) = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$. What is $\lim_{t \to \infty} \mathbf{x}(t)$?

13. Find the general solution to the system $\mathbf{x}' = \begin{pmatrix} 4 & 1 \\ 2 & 5 \end{pmatrix} \mathbf{x} + \begin{pmatrix} e^{-t} \\ t \end{pmatrix}$.

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