Problem 1

© Problem 1; TAMUDFEQ activated.

© BDP10, Page 363, Problem 2

© \( u'' + \frac{1}{2}u' + 2u = 3\sin(t) \)

© Let \( x_1 = u \) and \( x_2 = u' \).

© Then \( x_1' = u' = x_2 \).

© And \( x_2' = u'' = 3\sin(t) - \frac{1}{2}u' - 2u = 3\sin(t) - \frac{1}{2}x_2 - 2x_1 \).

© Now put this in matrix–vector format.

© \[
\begin{bmatrix}
  x_1 \\
  x_2
\end{bmatrix} = \begin{bmatrix}
  0 & 1 \\
  -2 & -\frac{1}{2}
\end{bmatrix} \begin{bmatrix}
  x_1 \\
  x_2
\end{bmatrix} + \begin{bmatrix}
  0 \\
  3\sin(t)
\end{bmatrix}
\]

© \( x' = Ax + f \), a nonhomogeneous system since \( x' - Ax = f \neq 0 \) vector.
Problem 2

© Problem 2; TAMUDFEQ activated.

© BDP10, Page 363, Problem 4

© $u^{(4)} - u = 0$

© Let $x_1 = u$, $x_2 = u'$, $x_3 = u''$, $x_4 = u'''$.

© Then $x_1' = u' = x_2$.

© And $x_2' = u'' = x_3$.

© And $x_3' = u''' = x_4$.

© Finally, $x_4' = u^{(4)} = u = x_1$.

© Now put this in matrix–vector format.

\[
\begin{bmatrix}
  x_1 \\
  x_2 \\
  x_3 \\
  x_4
\end{bmatrix}' = \begin{bmatrix}
  0 & 1 & 0 & 0 \\
  0 & 0 & 1 & 0 \\
  0 & 0 & 0 & 1 \\
  1 & 0 & 0 & 0
\end{bmatrix} \begin{bmatrix}
  x_1 \\
  x_2 \\
  x_3 \\
  x_4
\end{bmatrix} + \begin{bmatrix}
  0 \\
  0 \\
  0 \\
  0
\end{bmatrix}
\]

© $x' = Ax + 0$, a homogeneous system since $x' - Ax = 0$ vector.

©