FINAL EXAM (LENSTRA) - ANSWER KEY

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(1)

\[ x(t) = e^{-2t} \begin{bmatrix} 3 \\ -1 \end{bmatrix} + e^{-3t} \begin{bmatrix} -2 \\ 4 \end{bmatrix} \]

(2) (a) You really just do this by guessing! Start with 1 and \( x \), and modify your guess!

\[ y_1(x) = 1, \quad y_2(x) = x \quad y_3(x) = \frac{1}{16} e^{4x} \]

(b) Yes! The Wronskian is identically zero, hence nonzero at some point, and that is enough to determine linear independence!

(3)

\[ (D + 1)(D^2 + 4)[y] = 0 \]

I found this because \( e^{-x} \) corresponds to a root \( r = -1 \) and \( \cos(2x) \) corresponds to a root \( r = 2i \). Hence I looked for a simple equation which has roots \(-1, \pm 2i\).

\[ y(t) = Ae^{-t} + B \cos(2t) + C \sin(2t) \]

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\[ u(x, t) = \cosh(3t) \sin(3x) \]