Př: $y_1' = y_1 - 3y_2$

$y_2' = 3y_1 + y_2$

$y' = \begin{pmatrix} 1 & -3 \\ 3 & 1 \end{pmatrix}$

už vím!

2 jak :)

vl. č. $\begin{vmatrix} 1-\lambda & -3 \\ 3 & 1-\lambda \end{vmatrix} = \lambda^2 - 2\lambda + 10 = 0 \longrightarrow \lambda_{1,2} = \frac{2 \pm \sqrt{4-40}}{2} = \frac{2 \pm \sqrt{-36}}{2} = 1 \pm 3i$

$\lambda_1 = 1 + 3i$

$u_1^* = h e^{\lambda x} = h e^{(1+3i)x}$

pak určíme h jako řešení SLD: $(A - \lambda_1 E)h = 0$

$u_1^* = \underbrace{Re\{u_1^*\}}_{u_1} + i\underbrace{Im\{u_1^*\}}_{u_2}$

$\lambda_1 = 1+3i \Rightarrow u_1^* = h_1 e^{(1+3i)x}$

$(A - \lambda_1 E)h = 0$

jak? 2

$\begin{pmatrix} -3i & 3 \\ 3 & -3i \end{pmatrix} \begin{pmatrix} h_1 \\ h_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

$\begin{pmatrix} 3 & -3i \\ 3 & -3i \end{pmatrix} \begin{pmatrix} h_1 \\ h_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \xrightarrow{\Delta h} \begin{pmatrix} 3 & -3i \\ 0 & 0 \end{pmatrix} \begin{pmatrix} h_1 \\ h_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

$3h_1 = 3ih_2$

$h_1 = ih_2$

v = $h_2 = 1 \Rightarrow h_1 = i$

$h = \begin{pmatrix} i \\ 1 \end{pmatrix}$

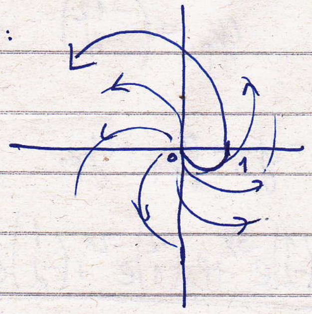
$i^2 = -1$

$u_1^* = \begin{pmatrix} i \\ 1 \end{pmatrix} e^{(1+3i)x} = \begin{pmatrix} i \\ 1 \end{pmatrix} e^x [\cos(3x) + i\sin(3x)] = e^x \begin{pmatrix} i\cos(3x) - \sin(3x) \\ \cos(3x) + i\sin(3x) \end{pmatrix} =$

$u_1 = \underbrace{e^x \begin{pmatrix} -\sin(3x) \\ \cos(3x) \end{pmatrix}}_{u_1 = R\{u_1^*\}} + \underbrace{ie^x \begin{pmatrix} \cos(3x) \\ \sin(3x) \end{pmatrix}}_{u_2 = Im\{u^*\}}$

$$y = c_1 \cdot e^x \begin{pmatrix} -\sin(3x) \\ \cos(3x) \end{pmatrix} + c_2 i e^x \begin{pmatrix} \cos(3x) \\ \sin(3x) \end{pmatrix}$$

fázový portrét:



$c_1 = 0$

$c_2 = 1$

$x = 0$