

$$\dot{x} = Ax + bu$$

$$b = \begin{bmatrix} 100 \\ 0 \\ 0 \end{bmatrix}$$

$$A = \begin{bmatrix} -10 & 0 & -100 \\ 0 & 0 & 1 \\ 10000 & -10000 & 0 \end{bmatrix}$$

$$\lambda_{1,2} = -5 \pm j1005 \quad \leftarrow \text{FAST MODE} \}$$

$$\lambda_3 = -0.1 \quad \leftarrow \text{SLOW MODE} \}$$

stiff SYSTEM

STABLE

$e^{-0.1t}$

$$\frac{x_{k+1} - x_k}{h} = Ax_k + bu_k.$$

$$x_{k+1} = \underbrace{(I + Ah)}_{\text{matrix}} x_k + bh u_k.$$

$$|1 + \lambda_i h| < 1 \quad \lambda_i \rightarrow \begin{array}{l} i^{\text{th}} \\ \text{eigenvalue} \end{array}$$

$$|1 + \lambda_i h| < 1$$

$$\lambda_1 = \underline{-5 + j1005}$$

$h \rightarrow$ time step.

$$\rightarrow 1005 \text{ rad/s.}$$

$$f = \frac{1005}{2\pi}$$

$$|(1 - 5h) + j(1005h)| < 1 \quad T = \frac{1}{f}$$

$$\cancel{1} (1 - 5h)^2 + (1005h)^2 < 1$$

$$h = 0.001 \text{ s}$$

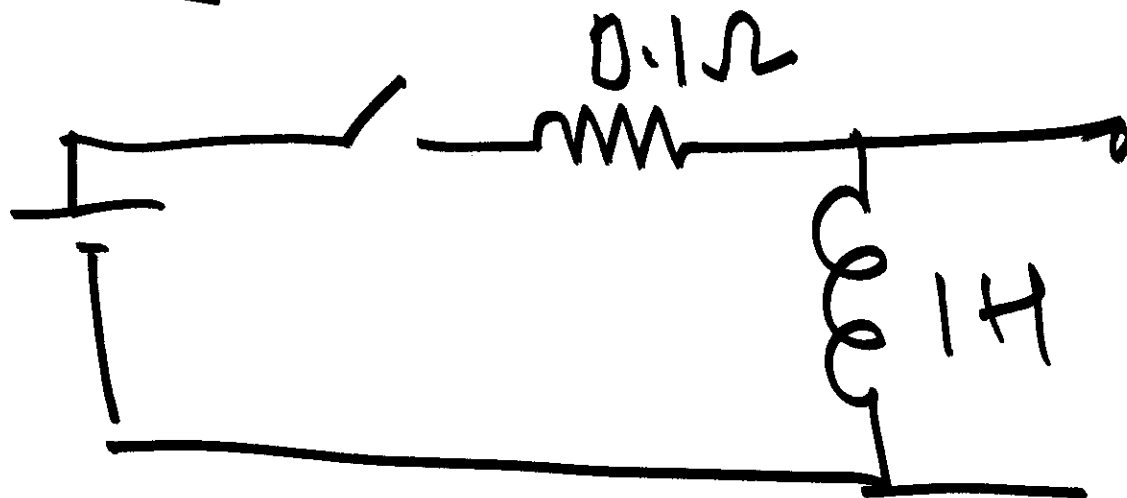
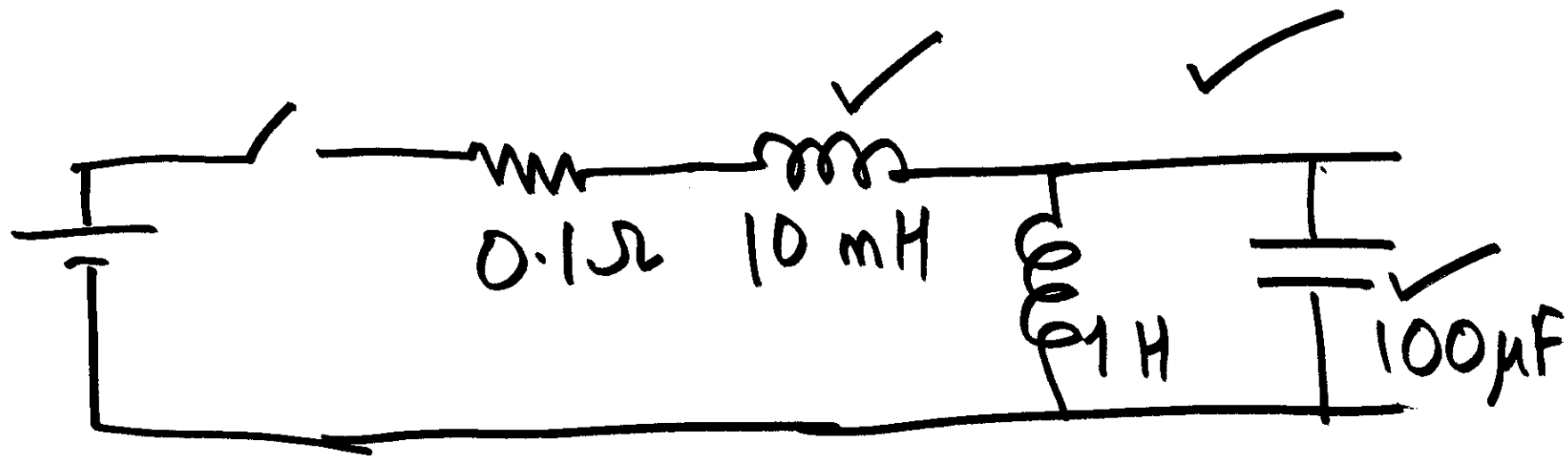
$$\dot{i}_1 = 10 - 10e^{-0.1t} + 0.1e^{-5t} \times \sin(1005t)$$

$$\dot{i}_2 = 10 - 10e^{-0.1t}$$

$$v_c = e^{-0.1t} - e^{-5t} \cos(1005t)$$

$$\dot{x} = Ax + bu$$

$$\begin{array}{l} \text{B.E} \\ \hline \end{array} \frac{x_{k+1} - x_k}{h} = Ax_{k+1} + bu_{k+1}$$
$$x_{k+1} = \begin{array}{l} (I - Ah)^{-1} \\ \text{~~Ah~~} \end{array} x_k + (I - Ah)^{-1} bh u_{k+1}$$



E
BE
TR

$R=1S$

R-K 4th

Trap

$$\frac{x_{k+1} - x_k}{h} = \frac{A x_{k+1} + A x_k}{2} + b \left(\frac{u_{k+1}}{2} \right) + b \frac{u_k}{2}.$$

$$\underline{\dot{x} = f(x)}$$