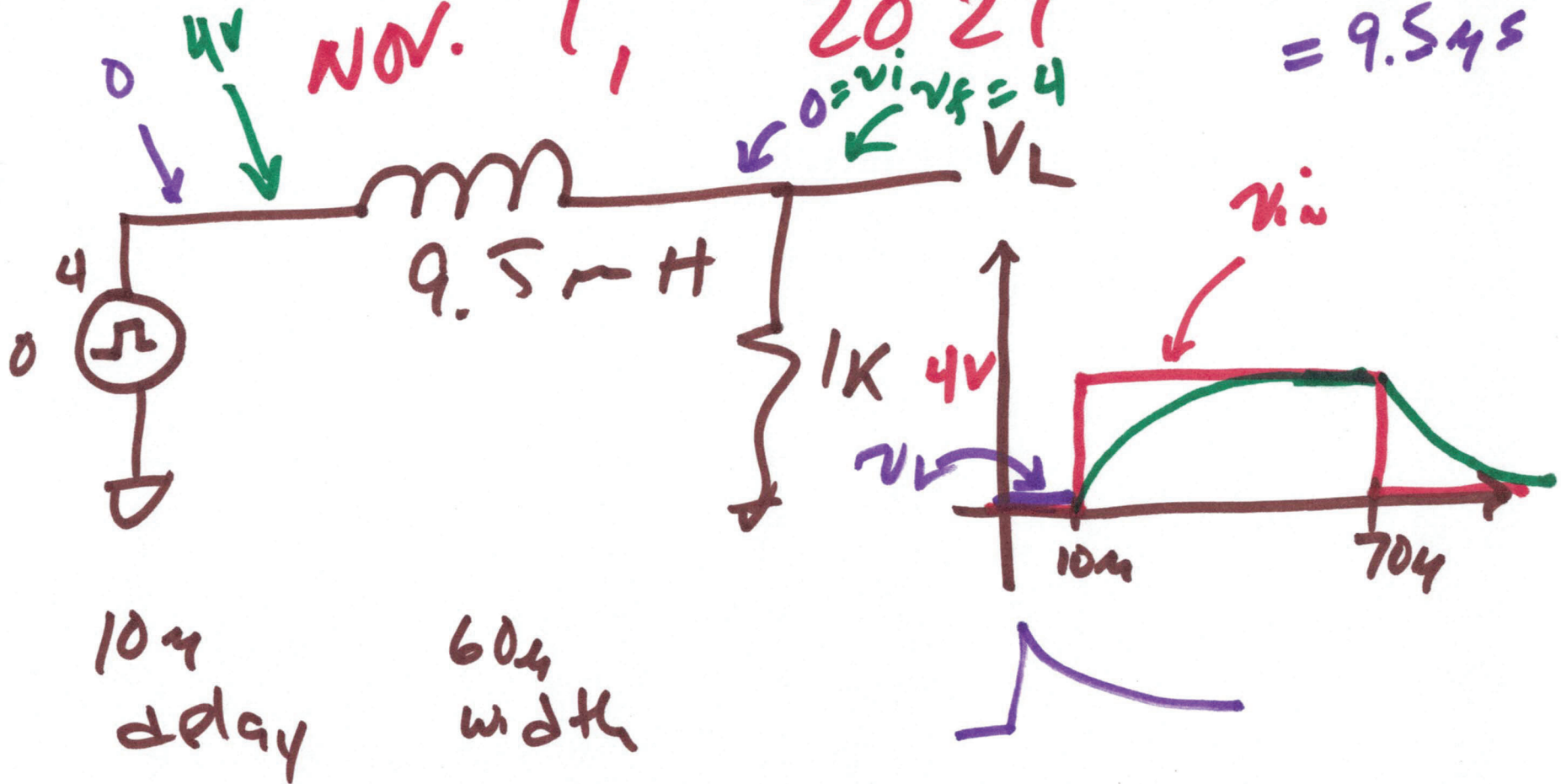


# EE 220 circuits 1

## Lecture 19

$$\tau = \frac{L}{R} = \frac{9.5 \mu\text{s}}{1\text{k}} = 9.5 \mu\text{s}$$

NOV. 1, 2021  
 $v_i = v_f = 4$



17

$$v_L(t) = 4 + (0-4)e^{-(t-10\mu s)/9.5\mu s} \quad 10\mu s \leq t \leq 70\mu s$$

$$= 4 - 4e^{-(t-10\mu s)/9.5\mu s}$$

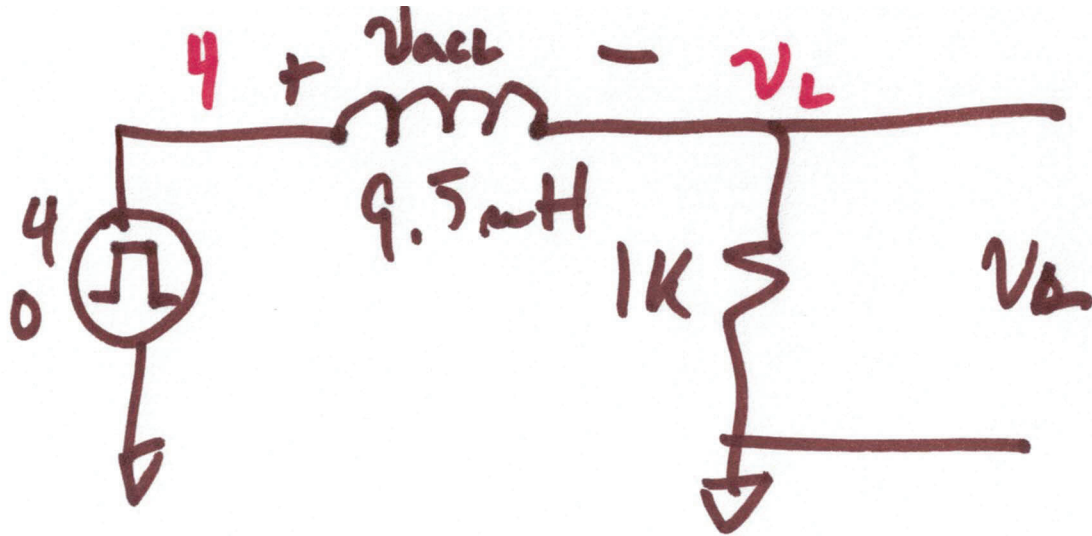
$$v_L(t) = 4e^{-(t-70\mu s)/9.5\mu s} \quad t \geq 70\mu s$$

$$i(t) = \frac{v_L(t)}{1k} = 4mA(1 - e^{-(t-10\mu s)/9.5\mu s}) \quad 10\mu s \leq t \leq 70\mu s$$

V across inductor = ~~input~~  $v_L$

$$= 4mA e^{-(t-70\mu s)/9.5\mu s} \quad t \geq 70\mu s$$

2)

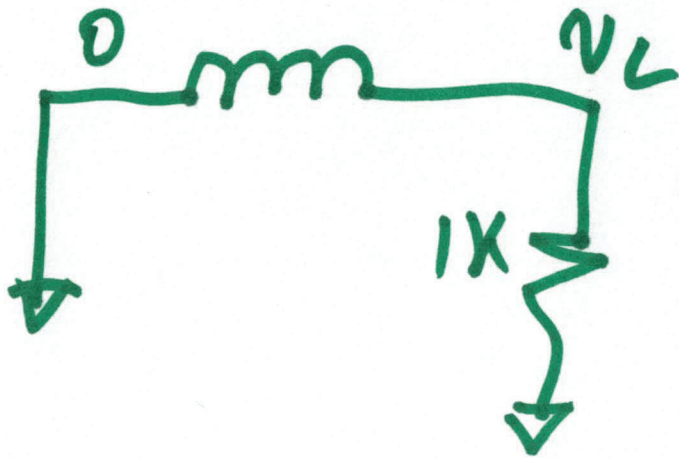


$$-(t-10\mu)/9.5$$

$$10\mu \leq t \leq 70\mu \quad 4+4e$$

$$v_{acL} = 4 - v_L(t) \\ = 4 - (t-10\mu)/9.5 \\ = +4e$$

3)



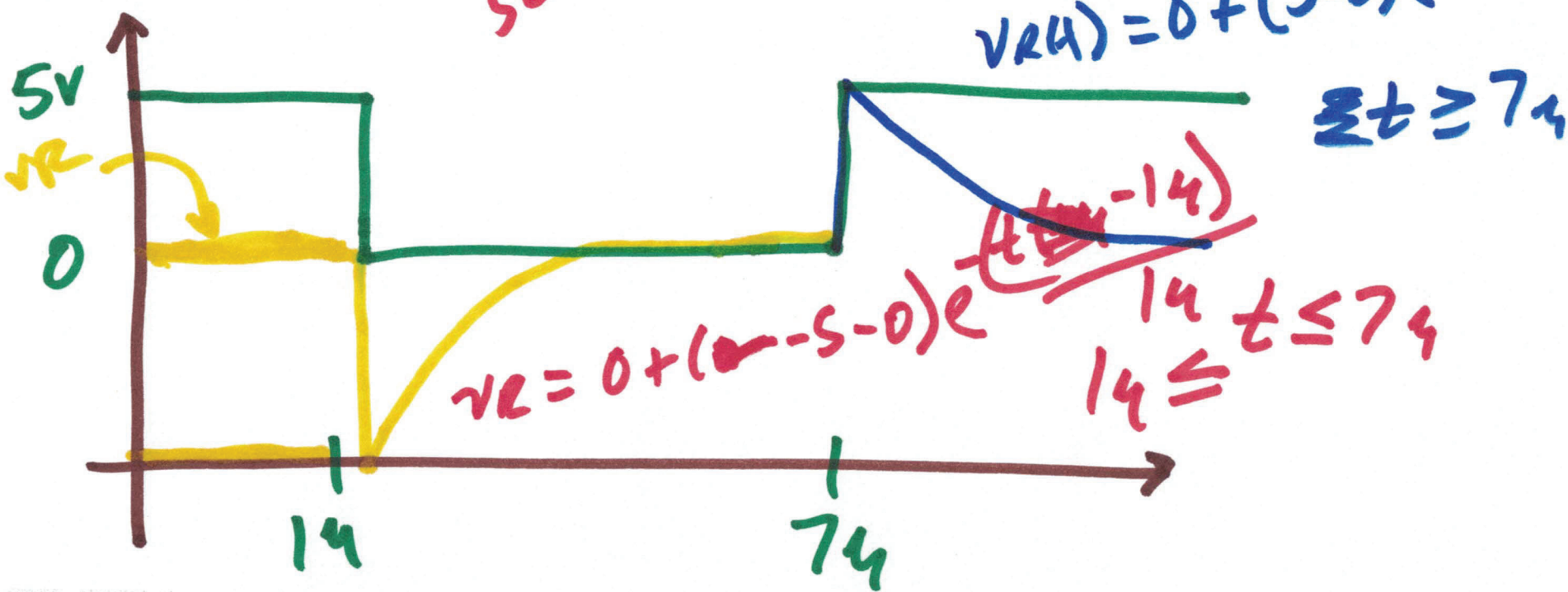
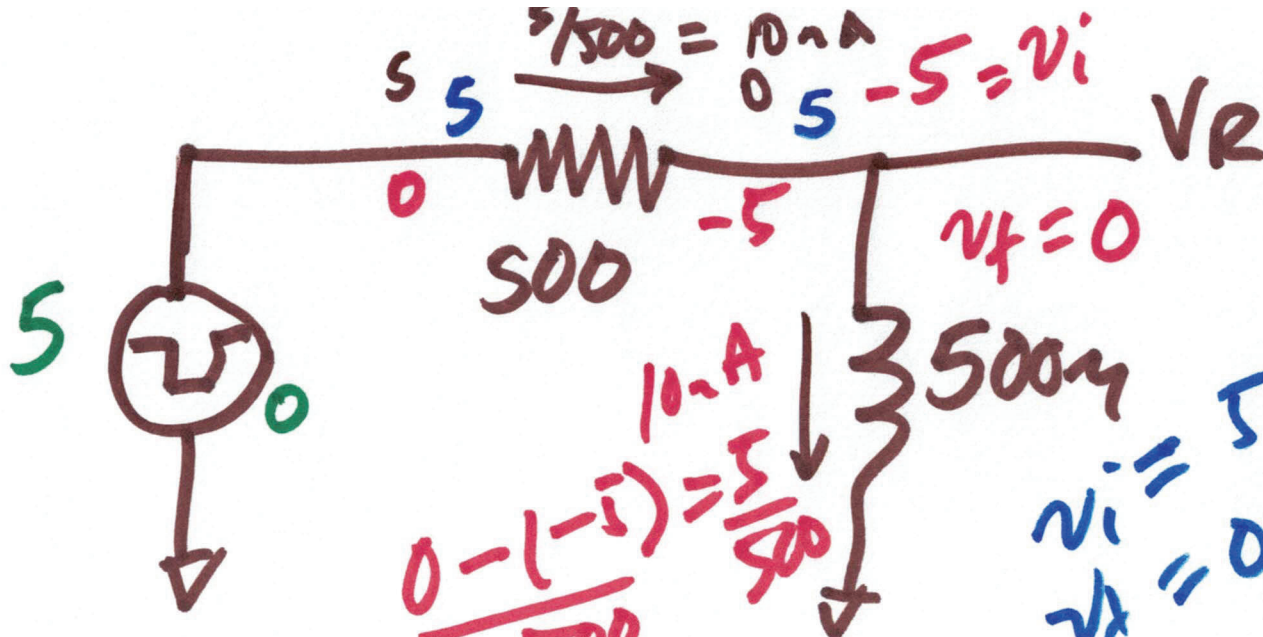
$$t \geq 70 \mu\text{s}$$

$$v_L(t) = 4 e^{-(t-70\mu)/9.54}$$

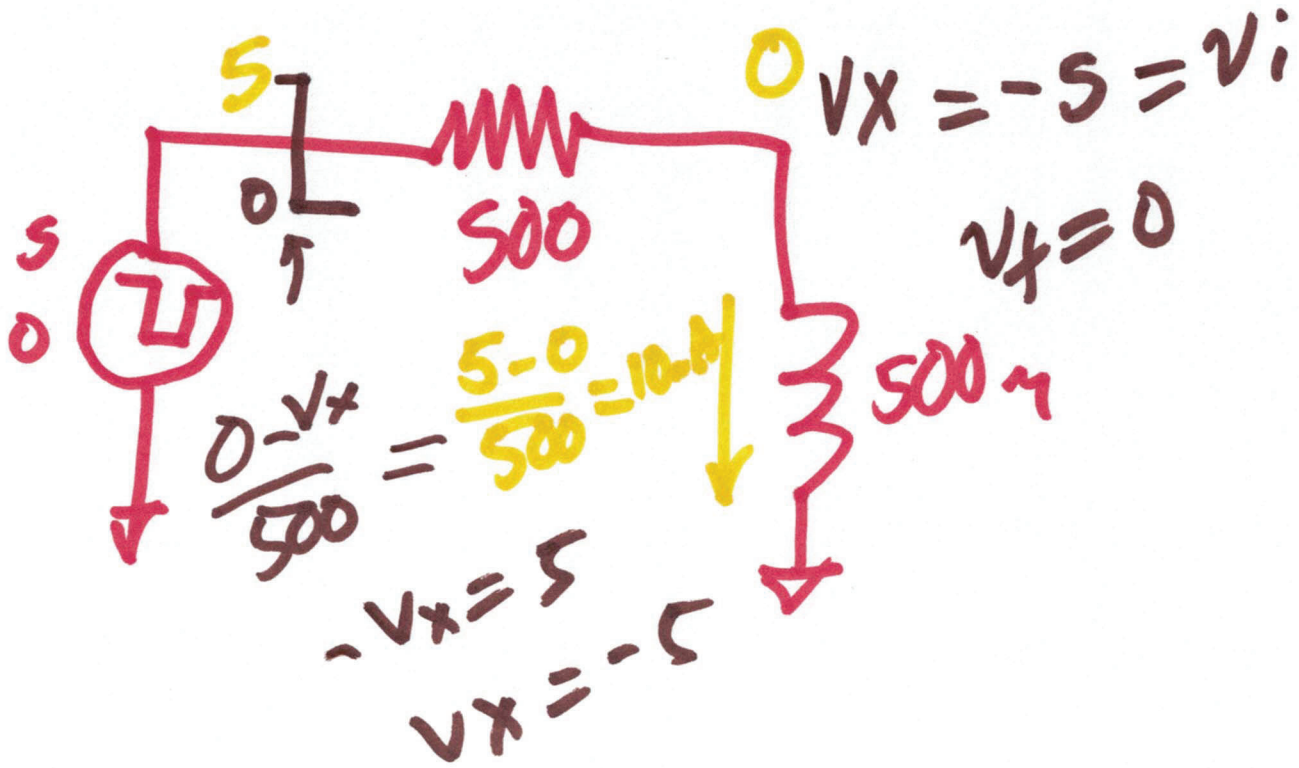
$$v_{acL} = 0 - v_L(t)$$

$$= -4 e^{-(t-70\mu)/9.54}$$





5)



$$v_R(t) = \cancel{5} + 0 + (-5 + 0)e^{\frac{-(t-1\mu)}{1\mu}}$$

$$1\mu \leq t \leq 7\mu$$

# Energy, Joules

$$\Sigma = \int_{t_1}^{t_2} \text{power} \cdot dt$$

$$\text{power} = v(t) \cdot i(t)$$

inductor  $\rightarrow v(t) = L \cdot \frac{di}{dt}$

$$\Sigma = \int_0^t v(t) \cdot i(t) \cdot dt = \int_0^t L \cdot \frac{di}{dt} \cdot i \cdot dt$$

$$\Sigma = L \int_0^t i \cdot di$$

$$\mathcal{E} = L \int_0^{I} i \, di = L \cdot \frac{1}{2} i^2$$

$$\mathcal{E} = \frac{1}{2} L I^2$$

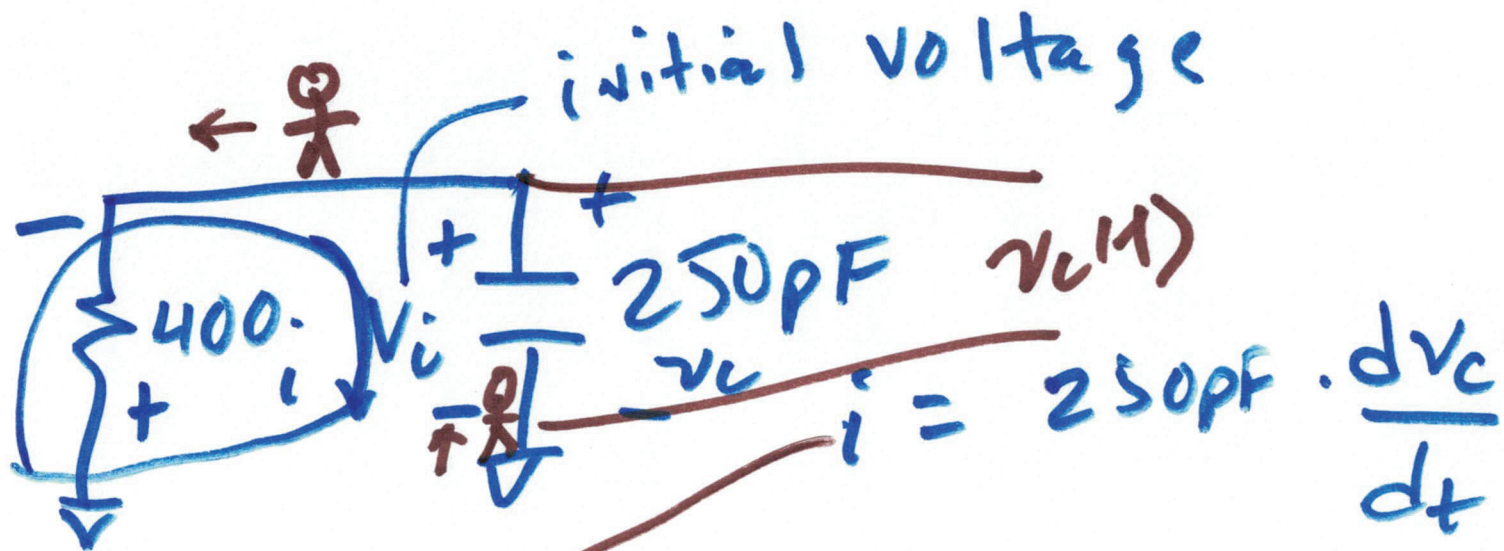
$$i = C \frac{dv}{dt}$$

$$\mathcal{E} = \int_0^t v \cdot i \, dt = \int_0^v v \cdot C \cdot \frac{dv}{dt} \cdot dt$$

$$\mathcal{E} = \frac{1}{2} C v^2$$

2)





$$+400i + v_c(t) = 0$$

$$R \cdot C \cdot \frac{dv_c}{dt} + v_c = 0$$

$$400 \cdot 250 \text{ p} \cdot \frac{dv_c}{dt} + v_c = 0$$

$$RC \cdot \frac{dv_c}{dt} = -v_c$$

$$\int_{v_i}^{v_c(t)} \frac{dv_c}{v_c} = \int_0^t -\frac{1}{RC} dt$$

a)

$$\ln \times \left| \frac{v_c(t)}{v_i} \right. = -\frac{t}{RC}$$

$$\ln v_c(t) - \ln v_i = -\frac{t}{RC}$$

$$\ln a - \ln b = \ln \frac{a}{b}$$

$$\ln \frac{v_c(t)}{v_i} = -\frac{t}{RC}$$

$$\frac{v_c(t)}{v_i} = e^{-t/RC}$$

$$v_c(t) = v_i e^{-t/RC}$$