8-18 $V_C(t) = V_C(\infty) + [V_C(0^+) - V_C(\infty)]e^{-\frac{t}{\tau}}$, $t \geq 0$. $V_C(\infty)$ open voltage

(c) $V_C(0^+) = 10V$, $V_C(\infty) = V_{in}(t) = 20V$, $\tau = R_{th}C = RC = 4s$

$V_C(t) = 20 + [10-20]e^{-\frac{t}{4}} = \underline{20 - 10e^{-\frac{t}{4}}\ (V),\ t \geq 0}$

(d) $V_C(0) = -20V$, $V_C(\infty) = V_{in}(t) = -10V$, $\tau = R_{th}C = RC = 4s$

$V_C(t) = -10 + [-20-(-10)]e^{-\frac{t}{4}} = \underline{-10 - 10e^{-\frac{t}{4}}(V),\ t \geq 0}$

(e) Ohm's Law: $V_R(t) = I_C(t)R$, KVL: $V_{in}(t) = V_R(t) + \underbrace{V_C(t)}_{(c)}$

$I_C(t) = \frac{V_R(t)}{R} = \frac{V_{in}(t) - V_C(t)}{R} = \frac{1}{10k}[20 - (20 - 10e^{-\frac{t}{4}})]$

$= \underline{1 \times 10^{-3} e^{-\frac{t}{4}}\ (A),\ t \geq 0}$

8-19 $I_L(t) = I_L(\infty) + [I_L(0^+) - I_L(\infty)]e^{-\frac{t}{\tau}}$, $t \geq 0$. $I_L(\infty)$ short current

(c) $I_L(0^+) = -0.05A$, $I_L(\infty) = \frac{V_{in}(\infty) - \overset{0}{\cancel{V_L(\infty)}}}{R} = 0.2A$, $\tau = \frac{L}{R_{th}} = \frac{L}{R} = 2 \times 10^{-3}s$

$I_L(t) = 0.2 + [-0.05 - 0.2]e^{-\frac{t}{2\times10^{-3}}} = \underline{0.2 - 0.25e^{-500t}(A),\ t \geq 0}$

(d) $I_L(0) = 0.025A$, $I_L(\infty) = \frac{V_{in}(\infty) - \overset{0}{\cancel{V_L(\infty)}}}{R} = -0.1A$, $\tau = \frac{L}{R_{th}} = \frac{L}{R} = 2\times10^{-3}s$

$I_L(t) = -0.1 + [0.025 - (-0.1)]e^{-\frac{t}{2\times10^{-3}}} = \underline{-0.1 + 0.125e^{-500t}(A),\ t \geq 0}$

(e) KVL: $V_{in}(t) = V_R(t) + V_L(t)$, Ohm's Law: $V_R(t) = \underbrace{I_L(t)}_{(c)}R$

$V_L(t) = V_{in}(t) - I_L(t)R = 20 - (0.2 - 0.25e^{-500t})100$

$= \underline{25e^{-500t}\ (V),\ t \geq 0}$

$\tau = R_{th}C = (R_1 \| R_2)C = 0.1s$

$V_C(\infty) = \frac{R_2}{R_1+R_2}V_{in}(\infty) = 16V$

8-20 $V_C(t) = V_C(\infty) + [V_C(0^+) - V_C(\infty)]e^{-\frac{t}{\tau}}$, $t \geq 0$. $V_C(0^+) = V_C(0^-) = -8V$

(c) zero-input response: $V_C(\infty) = V_{in}(t) = 0$, no source input.

$V_{C1}(t) = V_C(t)\Big|_{V_C(\infty)=0} = V_C(0^+)e^{-\frac{t}{\tau}} = \underline{-8e^{-10t}(V),\ t \geq 0}$

zero-state response: $V_C(0^+) = 0$, no initial condition.

$V_{C2}(t) = V_C(t)\Big|_{V_C(0^+)=0} = V_C(\infty) - V_C(\infty)e^{-\frac{t}{\tau}} = \underline{16 - 16e^{-10t}(V),\ t \geq 0}$

Note: $V_C(t)$ is complete response: $V_C(t) = V_{C1}(t) + V_{C2}(t)$

(d) For $0 < t \leq 0.25$, switch is closed, diagram is the same as (c).

$V_C^I(t) = V_C^I(\infty) + [V_C^I(0^+) - V_C^I(\infty)]e^{-\frac{t}{\tau_I}} = 16 - 24e^{-10t}(V)$, $0 \leq t \leq 0.25$

$$I_C^I(t) = C\,\frac{dV_C^I(t)}{dt} = 2.5\times10^{-3}\left(240\,e^{-10t}\right) = \underline{0.6\,e^{-10t}(A),\ 0<t\le 0.25}$$

For $0.25 < t \le 0.5$ (or ∞), switch is open, diagram is changed.

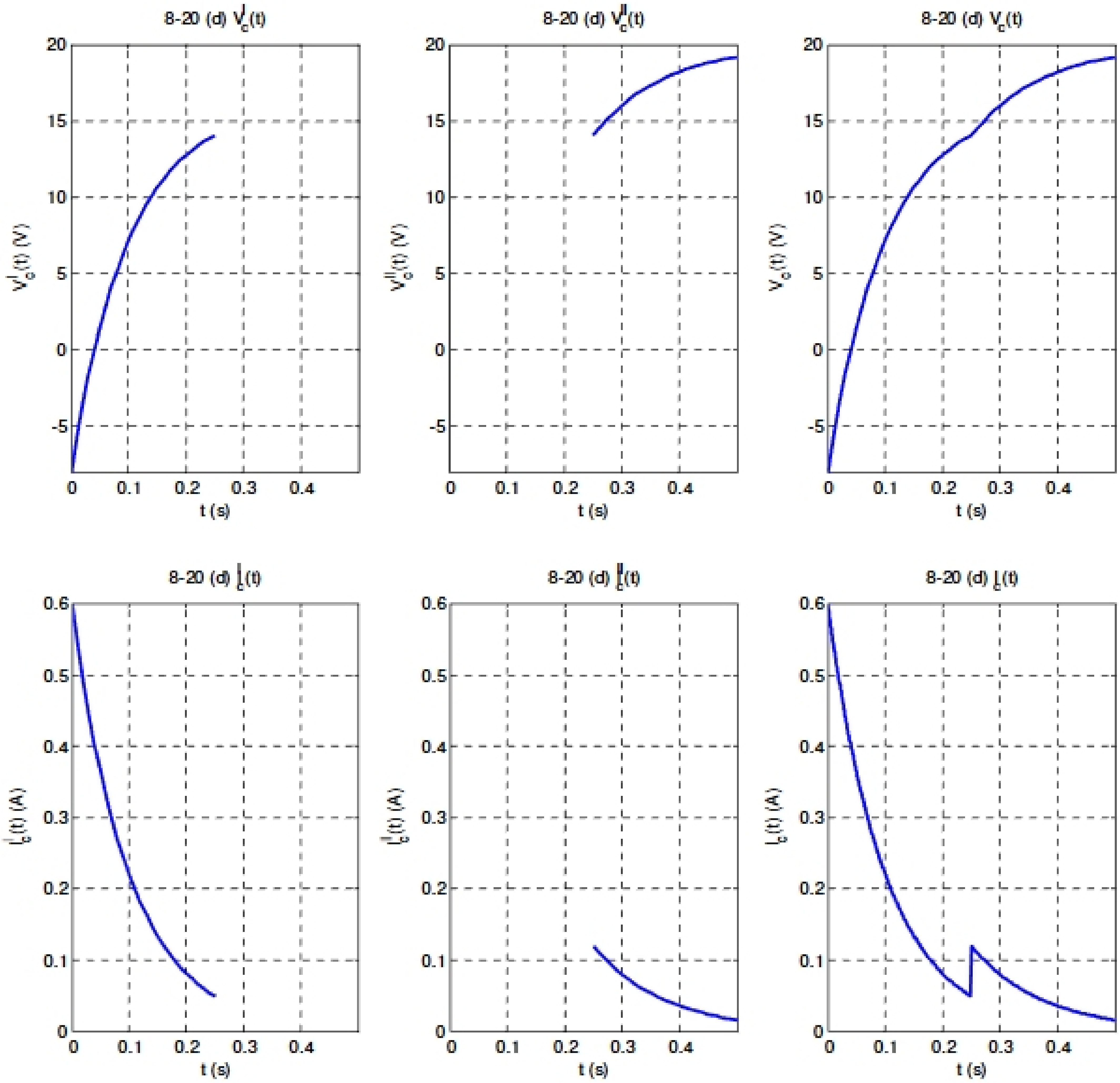
$$\tau_{II} = R_{th}^{II}C = R_1C = 50\,(2.5\times10^{-3}) = 0.125\ s\ ,\quad V_C(\infty) = V_{in}(\infty) = 20V$$

Initial condition: $V_C^{II}(0.25^+) = V_C^{I}(0.25^-) = V_C^I(t)\Big|_{t=0.25} = 16-24e^{-2.5} = 14.03\ V$

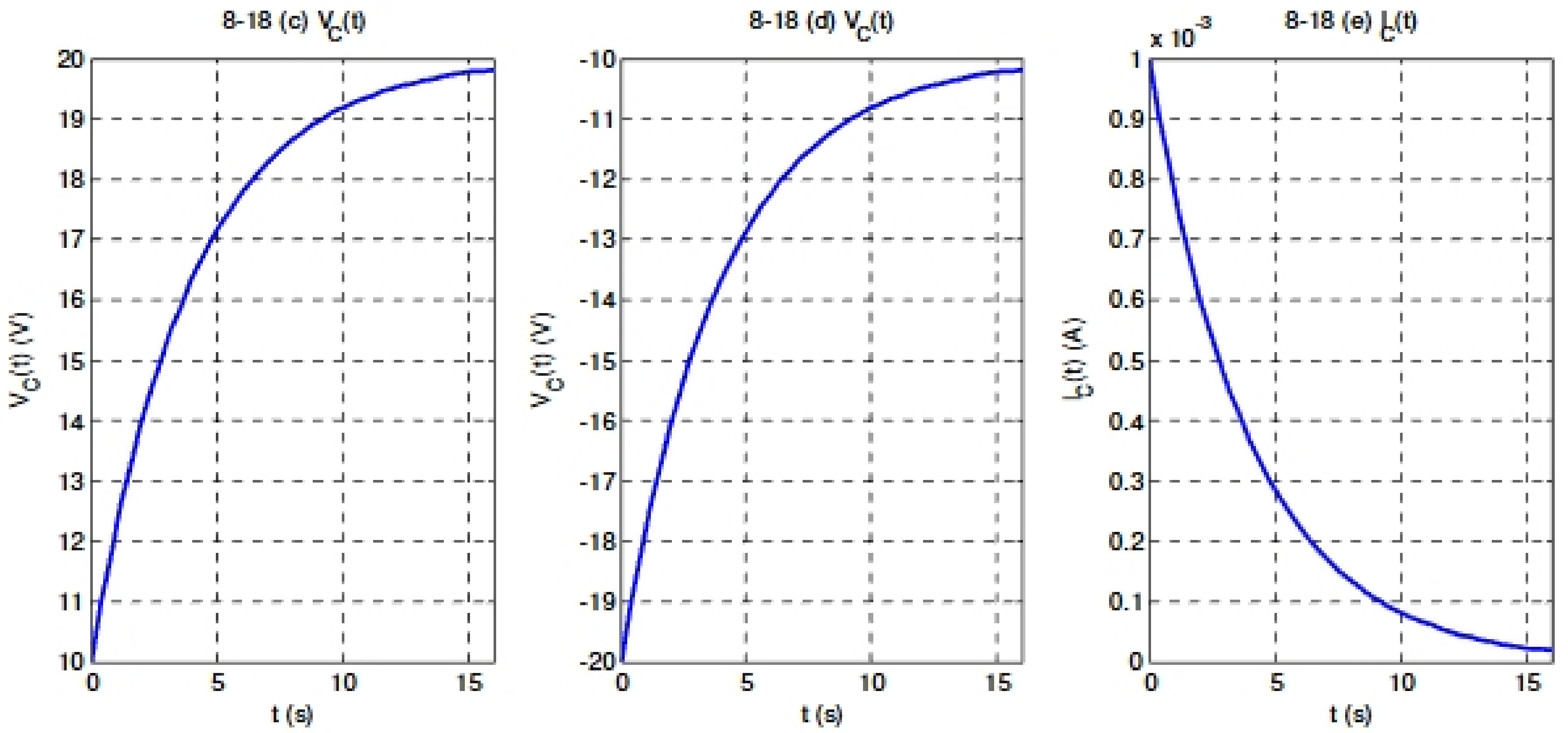
$$V_C^{II}(t) = V_C^{II}(\infty) + \left[V_C^{II}(0.25^+) - V_C^{II}(\infty)\right]e^{-\frac{t-0.25}{\tau_{II}}} = \underline{20-5.97e^{-8(t-0.25)}(V)}$$

$$I_C^{II}(t) = C\,\frac{dV_C^{II}(t)}{dt} = 2.5\times10^{-3}\left(47.76e^{-8(t-0.25)}\right) = \underline{0.1194e^{-8(t-0.25)}(A),\ 0.25<t\le 0.5}\ \text{(or}\ \infty\text{)}$$

$$\Rightarrow V_C(t) = \begin{cases} 16-24\,e^{-10t}(V), & 0\le t\le 0.25 \\ 20-5.97e^{-8(t-0.25)}(V), & 0.25<t\le 0.5\ \text{(or}\ \infty\text{)} \end{cases} \qquad I_C(t) = \begin{cases} 0.6\,e^{-10t}(A), & 0\le t\le 0.25 \\ 0.1194\,e^{-8(t-0.25)}(A), & 0.25<t\le 0.5\ \text{(or}\ \infty\text{)} \end{cases}$$

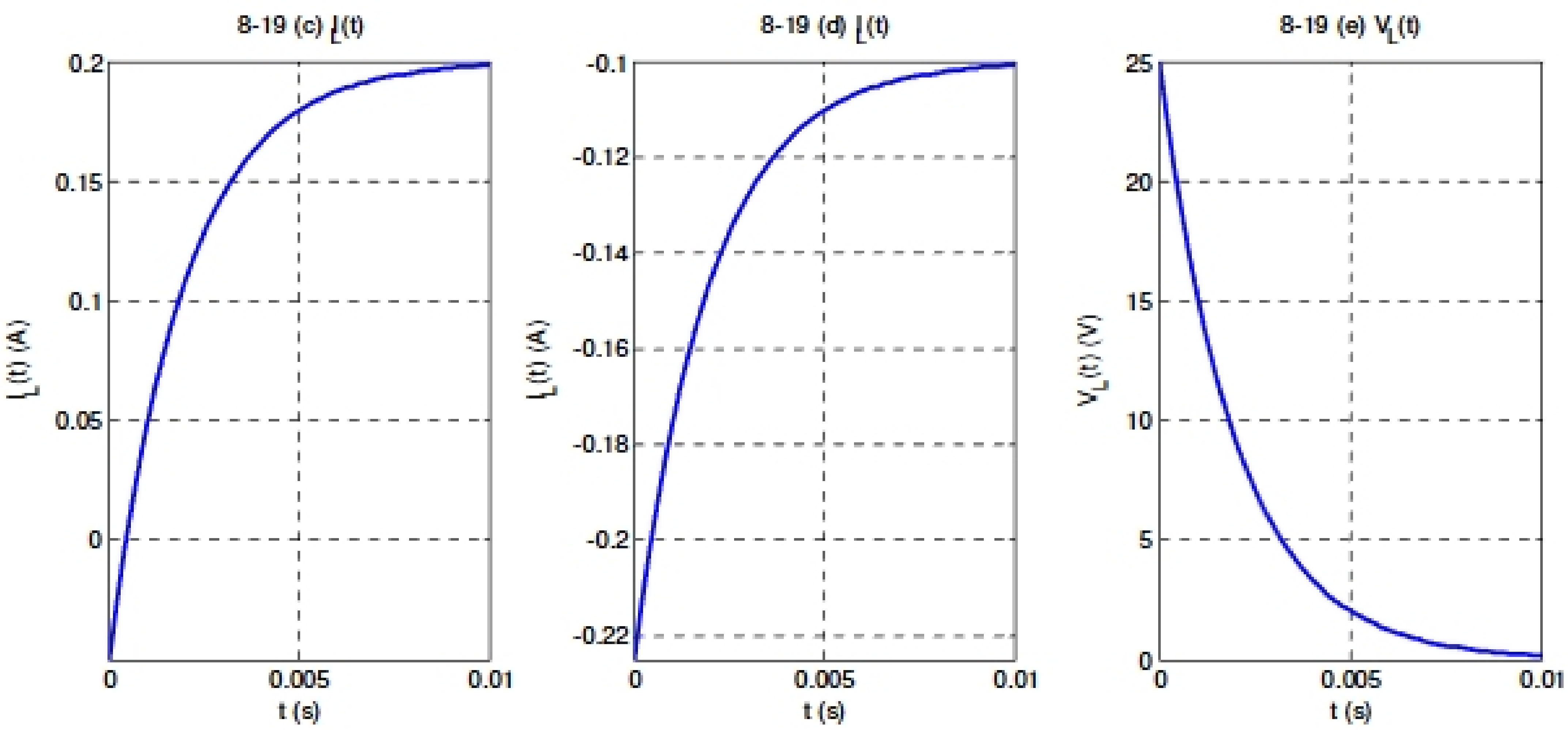


8-18



8-18 (c) V_C(t)
V_C(t) (V)
t (s)
8-18 (d) V_C(t)
V_C(t) (V)
t (s)
8-18 (e) I_C(t)
x 10^-3
I_C(t) (A)
t (s)

8-19



8-19 (c) I_L(t)
I_L(t) (A)
t (s)
8-19 (d) I_L(t)
I_L(t) (A)
t (s)
8-19 (e) V_L(t)
V_L(t) (V)
t (s)