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예제로 배우는 회로이론

연습문제 정답

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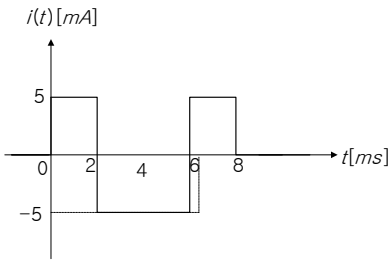
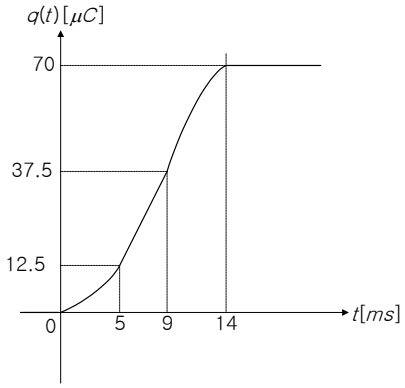
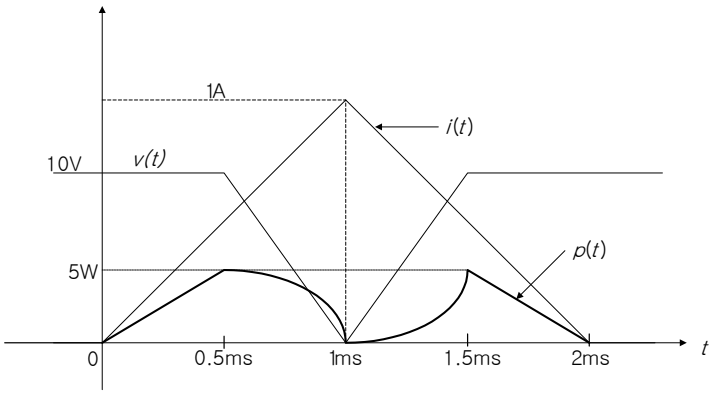
Chapter 01

번호	답
1.1	(a) $\lambda = 3[\mathrm{mm}]$ (b) $a = 100[\mathrm{km/s}]$ (c) $l = 100[\mu\mathrm{m}]$ (d) $W = 100[\mu\mathrm{W}]$
1.2	(a) $Q = 1.6[\mathrm{nC}]$ (b) $Q = 0.8[\mathrm{mC}]$ (c) $Q = 3.2[\mathrm{MC}]$ (d) $Q = 0.16[\mathrm{TC}]$
1.3	(a) $N = 6.25 \times 10^{18}$개 (b) $N = 6.25 \times 10^{15}$개 (c) $N = 6.25 \times 10^{12}$개 (d) $N = 6.25 \times 10^{10}$개
1.4	(a) $i(t) = -3 \times 10^3 \sin 10^3 t[\mathrm{A}]$ (b) $i(t) = -100e^{-10t}[\mathrm{mA}]$ (c) $i(t) = 5[\mu\mathrm{A}]$
1.5	
1.6	(a) $q(t) = 5t + 100\,[\mathrm{mC}]$ (b) $q(t) = 3\sin 10^3 t[\mu\mathrm{C}]$ (c) $q(t) = 5e^{-10t} - 3[\mathrm{C}]$
1.7	(a) $t < 0$: $i(t) = 0$, $0 \leqq t \leqq 5ms$: $i(t) = t[\mathrm{A}]$, $5ms \leqq t \leqq 9ms$: $i(t) = 5[\mathrm{mA}]$ $9ms \leqq t \leqq 14ms$: $i(t) = -10^3 t + 14[\mathrm{mA}]$, $t \geqq 14ms : i(t) = 0$ (b) $t < 0$: $q(t) = 0$, $0 \leqq t \leqq 5ms$: $i(t) = \int_0^t t dt + q(0) = \frac{1}{2}t^2[\mathrm{C}]$, $\mathrm{q}(5\mathrm{ms}) = 12.5[\mu\mathrm{C}]$, $5ms \leqq t \leqq 9ms : q(t) = \int_{5ms}^t 5 \times 10^{-3} dt + q(5ms) = 5 \times 10^{-3} t + 1.25 \times 10^{-5}$ $\therefore\ q(t) = 5 \times 10^3 t + 12.5[\mu\mathrm{C}]$, $\mathrm{q}(9\mathrm{ms}) = 57.5[\mu\mathrm{C}]$

	$9ms \leqq t \leqq 14ms:\ q(t) = \int_{9ms}^{t} \{-t + 14\times 10^{-3}\}dt + q(9ms)$ $\therefore\ q(t) = -\frac{1}{2}t^2 + 14\times 10^{-3}t - 28[\mu\mathrm{C}],\ \mathrm{q}(14\mathrm{ms}) = 70[\mu\mathrm{C}]$ $t \geqq 14ms: q(t) = 70[\mu\mathrm{C}]$ (c) 
1.8	(a) $v_{ab} = -0.1[\mathrm{V}]$ (b) $v_{ab} = 1.0[\mathrm{V}]$ (c) $v_{ab} = 1.4[\mathrm{V}]$
1.9	(a) $p_1 = 150[\mathrm{W}]$ (b) $p_2 = 50[\mathrm{W}]$ (c) $p_3 = 60[\mathrm{W}]$ (d) $p_4 = 50[\mathrm{W}]$ (e) $p_5 = 10[\mathrm{W}]$
1.10	(a) $p_1 = 50[\mathrm{W}]$ (b) $p_2 = 7[\mathrm{W}]$ (c) $p_3 = 8[\mathrm{W}]$ (d) $p_4 = 9[\mathrm{W}]$ (e) $p_5 = 10[\mathrm{W}]$ (f) $p_5 = 16[\mathrm{W}]$
1.11	(a) $W = 1.8[\mathrm{MJ}]$ (b) $W = 1.44[\mathrm{MJ}]$ (c) $W = 9.6[\mathrm{MJ}]$

1.12	
1.13	(a) $V=5I$ (b) $V=-10I$ (c) $V=5I-10$ (d) $V=10I+10$
1.14	(a) $i=3i_x$ (b) $v_6=6i_x$ (c) $v_2=2i$ (d) $v=4i$
1.15	$V_o=-197/2[\mathrm{V}]$
1.16	$P=80[\mathrm{W}]$
1.17	$R=2.5[\Omega]$
1.18	$240\,W$ 증가함
1.19	(a) $R_{100m}=35[\mathrm{V}]$ (b) $P=2[\mathrm{W}]$ (c) $R=6.37(\Omega cm)^{-1}$

Chapter 02

번호	답
2.1	(a) $I=4[\mathrm{A}]$ (b) $P=80[\mathrm{W}]$
2.2	$P=\frac{2420}{3}[\Omega]$
2.3	$R_1=4[\Omega],\ R_2=10[\Omega],\ I_1=1[\mathrm{A}],\ V_1=6\,V,\ V_2=4\,V$
2.4	$I_2=2[\mathrm{A}],\ I_3=1[\mathrm{A}],\ I_4=3[\mathrm{A}],\ I_1=6[\mathrm{A}]$
2.5	(a) $v_x=4[\mathrm{V}],\ V_s=1[\mathrm{V}],\ i_x=0.5[\mathrm{A}]$ (b) $P=5[\mathrm{W}]$
2.6	$V_1=20[\mathrm{V}]$ $V_2=40[\mathrm{V}]$
2.7	(a) $V_1:V_2=1:-2$ (b) $I_1=2[\mathrm{A}]$ (c) $P=40[\mathrm{W}]$ (d) $P=16[\mathrm{W}]$
2.8	$V_o=4[\mathrm{V}]$ $P=12[\mathrm{W}]$
2.9	$V_o=-4[\mathrm{V}]$ $P=-8[\mathrm{W}]$
2.10	$V_1=6[\mathrm{V}]$ $V_2=4[\mathrm{V}]$
2.11	$V=18[\mathrm{V}]$ $I_o=0.4[\mathrm{mA}]$
2.12	$I_o=\frac{4}{9}[\mathrm{mA}]$ $V_o=\frac{8}{3}[\mathrm{V}]$
2.13	$I_o=-\frac{1}{3}[\mathrm{A}]$
2.14	$I_s=\frac{5}{3}[\mathrm{mA}]$ $V_o=\frac{40}{9}[\mathrm{V}]$
2.15	$V_s=30[\mathrm{V}]$ $I_o=3[\mathrm{A}]$
2.16	$V_o=\frac{20}{3}[\mathrm{V}]$
2.17	(a) $R_{eq}=R$ (b) $R_{eq}=R$ (c) $R_{eq}=R$ (d) $R_{eq}=\frac{3}{5}R$
2.18	$R_{eq}=3.6[\Omega]$
2.19	$R_{ab}=\frac{83}{6}\Omega$
2.20	$I_s=\frac{32}{109}[\mathrm{A}]$
2.21	(a) $P_t=240[\mathrm{W}]$ (b) $P_t=15[\mathrm{W}]$

2.22	$R_{eq} = 20[\Omega]$
2.23	(a) $R_{ab} = 11.6[\Omega]$ (b) $R_{eq} = 5[\Omega]$
2.24	$V_o = 0.25[\mathrm{V}]$
2.25	$R_{eq} = 10[\Omega]$
2.26	$P_{BOX} = \frac{500}{3}[\mathrm{W}]$
2.27	(a) $V = 2I + 13/3$ (b) $V = 10I + 5$
2.28	(a) $V = 4I$ (b) $I = 3i_o + 18$
2.29	$V = 7I$

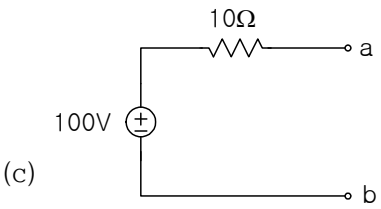
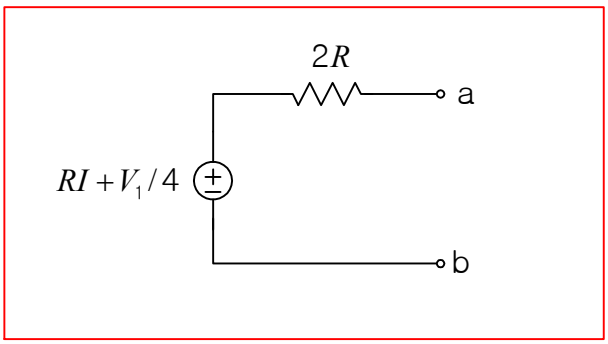
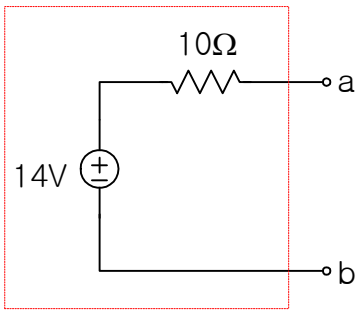
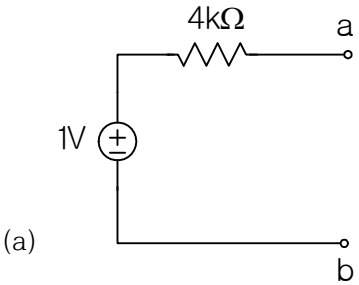
Chapter 03

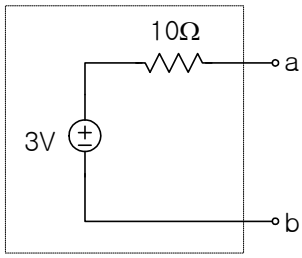
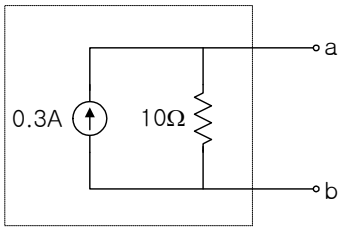
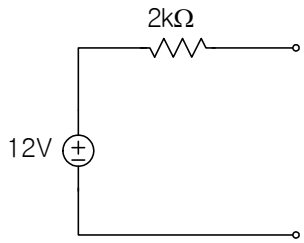
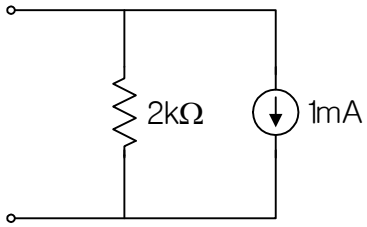
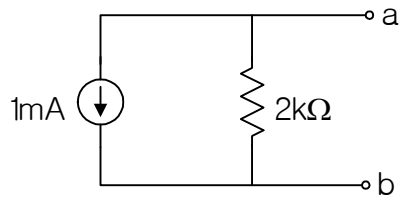
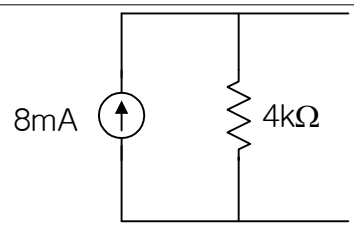
번호	답
3.1	$V_o = 2[\mathrm{V}]$
3.2	$V_o = 6[\mathrm{V}]$
3.3	$i_o = 5\mathrm{A}$
3.4	$v_x = 10[\mathrm{V}]$
3.5	$v_x = 2[\mathrm{V}]$
3.6	$v_x = 0$
3.7	$v_x = 1[\mathrm{V}]$
3.8	$v_x = 0,\ v_y = -7.5[\mathrm{V}]$
3.9	$i_o = 3[\mathrm{A}]$
3.10	$v_x = 2[\mathrm{V}],\ i_o = 0$
3.11	$V_o = 4[\mathrm{V}]$
3.12	$i_o = 1[\mathrm{A}]$
3.13	$V_x = 2[\mathrm{V}]$
3.14	$i_o = 1.5[\mathrm{A}]$
3.15	$i_x = 2[\mathrm{A}]$
3.16	$v_o = -2[\mathrm{V}]$
3.17	$v_x = 5[\mathrm{V}]$
3.18	$v_o = 10[\mathrm{V}]$
3.19	$V_x = -6[\mathrm{V}],\ i_o = 2[\mathrm{A}]$
3.20	$I_o = 1[\mathrm{A}],\ V_x = 4[\mathrm{V}]$
3.21	$I_o = 1[\mathrm{A}]$

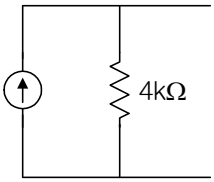
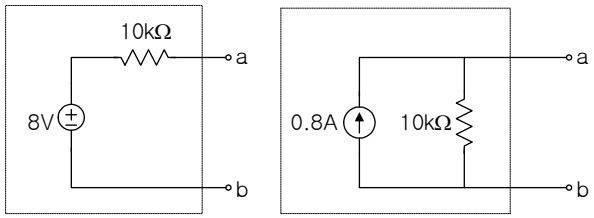
3.22	$V_o = 2[\mathrm{V}]$
3.23	$P_{R_L} = 5[\mathrm{W}]$
3.24	$V_x = 4[\mathrm{V}]$
3.25	$i_x = \frac{41}{42}[\mathrm{A}]$
3.26	$V_o = 10[\mathrm{V}]$
3.27	$P_{1A} = 2[\mathrm{W}]$

Chapter 04

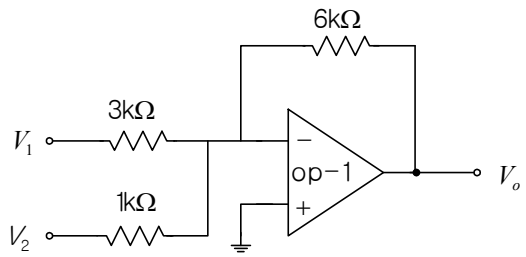
번호	답
4.1	(a) $v_s = 40[\mathrm{V}]$ (b) $i = 0.25[\mathrm{A}]$
4.2	(a) $v_s = 45[\mathrm{V}]$ (b) $v_o = \frac{10}{9}[\mathrm{V}]$
4.3	(a) $v_o = 10[\mathrm{V}]$ (b) $i_s = 1[\mathrm{A}]$ (c) $v_o = 14[\mathrm{V}]$
4.4	$V_o = 2[\mathrm{V}]$
4.5	$V_x = -2[\mathrm{V}]$
4.6	$I_1 = -1[\mathrm{A}]$
4.7	$P_{\text{공급}} = -42[\mathrm{W}]$
4.8	(a) $v_o = 12[\mathrm{V}]$ (b) $P_{2\Omega} = 72[\mathrm{W}]$
4.9	$V_x = -24[\mathrm{V}]$
4.10	$V_o = \frac{1}{3}\left(\frac{V_1}{8} + \frac{V_2}{4} + \frac{V_3}{2}\right)$
4.11	$V = 10I + 10$
4.12	$I = \frac{V}{4} - 2.5$ 혹은 $V = 4I + 10$
4.13	$V = 7I + 12$
4.14	$v = 8i + 32$
4.15	$v_x = 1\mathrm{V}$
4.16	$V_o = \frac{1}{3}\left(\frac{V_1}{8} + \frac{V_2}{4} + \frac{V_3}{2}\right)$
4.17	(a) $v = 10i + 100$ (b) $V_{OC} = 100[\mathrm{V}],\ R_{TH} = 10[\Omega]$

	 (c)
4.18	
4.19	$V_s = 12[\mathrm{V}]$
4.20	
4.21	 (a) (b) $v_o = 0.5[\mathrm{V}]$
4.22	(a) $V = 10 \cdot I + 3,\ I = 0.1V - 0.3$

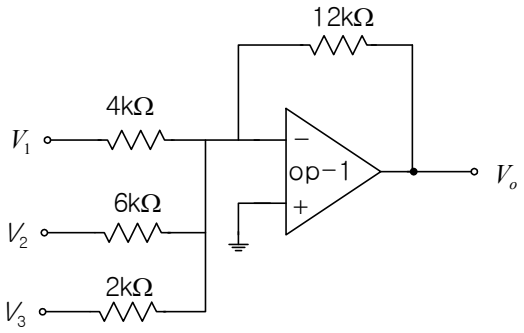
	(b)  (c) 
4.23	(a)  (b)  (c) $v_o = 4.2[\mathrm{V}]$
4.24	(a) $i_{SC} = -1[\mathrm{mA}],\ R_{TH} = 2[\mathrm{k}\Omega]$ (b) $i_{SC} = -1[\mathrm{mA}],\ R_{TH} = 2[k\Omega]$ (c) 
4.25	$I_o = \frac{10}{7}[\mathrm{A}]$
4.26	(a) 

	(b) $\therefore\ I=\dfrac{V}{4\mathrm{k}\Omega}-2[\mathrm{mA}]$ (c) 
4.27	(a)  테브난 등가회로 노턴의 등가회로 (b) $v_o=3[\mathrm{V}]$
4.28	$P_{\max}=10[\mathrm{mW}]$
4.29	$V_s=-75[\mathrm{V}]\ \text{or}\ 105[\mathrm{V}]$
4.30	$R_L=20[\Omega],\ P_{\max}=20[\mathrm{W}]$
4.31	$R_L=3[\Omega],\ P_{\max}=\dfrac{4}{3}[\mathrm{W}]$
4.32	$R_L=4[\Omega],\ P_{\max}=\dfrac{(10\mathrm{V})^2}{4\Omega}=25[\mathrm{W}]$
4.33	$R_L=4[\Omega],\ P_{4\Omega}=1[\mathrm{W}]$
4.34	$R_L=10[\Omega],\ P_{\max}=0.1[\mathrm{W}]$
4.35	$R_L=3[\Omega],\ P_{\max}=\dfrac{25}{12}[\mathrm{W}]$

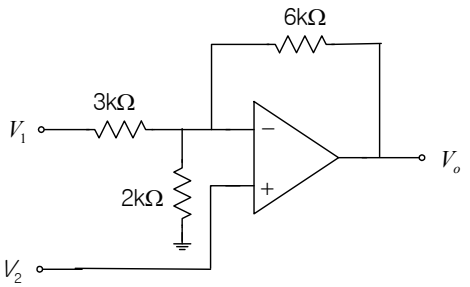
Chapter 05

번호	답
5.1	$\frac{v_o}{v_i}=\frac{10^{-2}+10^{8}}{10^{-2}+10^{3}+10^{8}}\simeq 1$
5.2	(a) $\frac{v_o}{v_i}=1$ (b) $\frac{v_o}{v_i}=\frac{10^{-2}+10^{8}}{10^{-2}+10^{3}+10^{8}}\simeq 1$
5.3	$I_o=1.6[\mathrm{mA}]$
5.4	$I_o=-8[\mathrm{mA}],\ \ V_o=-15[\mathrm{V}]$
5.5	$V_o=-2.5[\mathrm{V}]$
5.6	$v_o/v_i=-3$
5.7	$V_o=-8\,V_i$
5.8	$v_o=\left(1+\frac{R_4}{R_3}\right)\cdot\left(\frac{R_1\cdot R_2}{R_1+R_2}\right)\cdot\left(\frac{v_1}{R_1}+\frac{v_2}{R_2}\right)$
5.9	$I_o=4.6[\mathrm{mA}]$
5.10	$i_o=-1.6[\mathrm{mA}]$
5.11	$v_o=-5v_1+\frac{13}{4}v_2$
5.12	$V_o=10[\mathrm{V}]$
5.13	$i_o=1.2[\mathrm{mA}],\ \ v_o=10[\mathrm{V}]$
5.14	$v_o=-3v_1+\frac{5}{2}v_2$
5.15	$v_o=-a(v_1+v_2)+(a+1/2)(v_3+v_4)$
5.16	(a) 

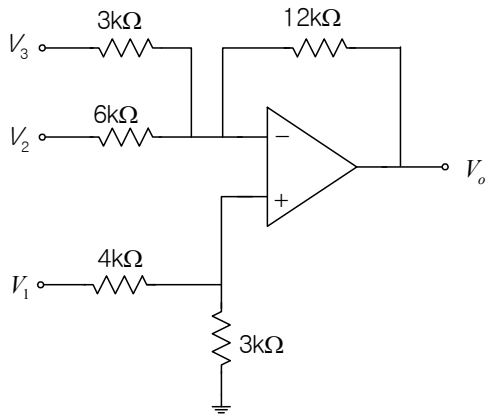
(b)

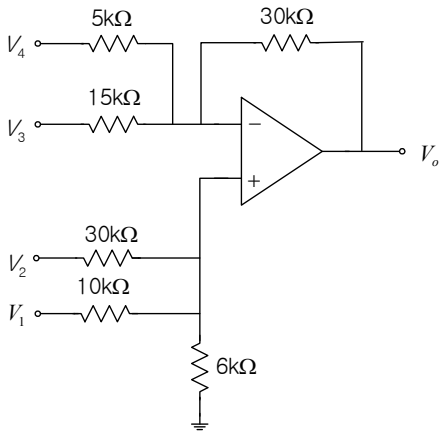

12kΩ
4kΩ
V_1
6kΩ
V_2
2kΩ
V_3
op-1
V_o

(c)


6kΩ
3kΩ
V_1
2kΩ
V_2
V_o

(d)


3kΩ
12kΩ
V_3
6kΩ
V_2
4kΩ
V_1
3kΩ
V_o

	(e) 
5.17	$\frac{v_o}{v_i} = -40$
5.18	$I_o = -5[\mathrm{mA}],\ \ V_o = 5[\mathrm{V}]$
5.19	$V_o = 4\,V_i$
5.20	$v_s = -0.8[\mathrm{V}]$
5.21	$V_o = -15\,V_1 - 2\,V_2$
5.22	$a = \frac{1}{3},\ b = \frac{1}{2},\ d = \frac{3}{2}$
5.23	$R = 5[\mathrm{k}\Omega]$
5.24	$R_1 = 5[\mathrm{k}\Omega],\ \ R_2 = 5[k\Omega]$
5.25	$V_o = -8\,V_1 - 6\,V_2$
5.26	$I_o = 1[\mathrm{mA}]$

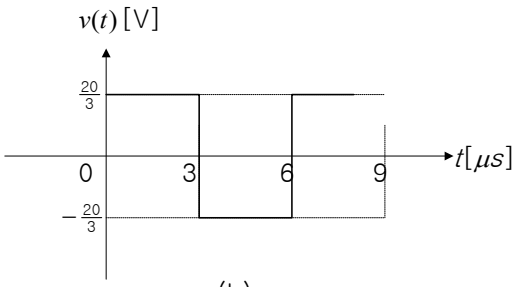
Chapter 06

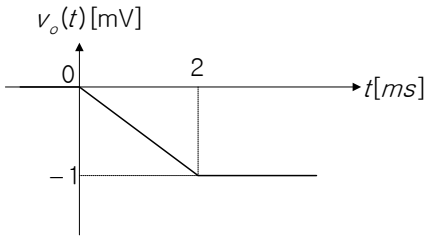
번호	답
6.1	(a) $G(s)=\frac{1}{s+3}$ (b) $F(s)=\frac{1}{s^2}$ (c) $H(s)=\frac{s}{s^2+25}$
6.2	(a) $G(s)=3$ (b) $F(s)=\frac{2}{s^2}e^{-3s}$ (c) $H(s)=\frac{1}{s+3}e^{-2(s+3)}$ (d) $H(s)=\frac{e^{-2s}}{s^2+1}$
6.3	(a) $F(s)=\frac{2}{(s+3)^2+4}$ (b) $G(s)=e^{-2(s+2)}\left\{\frac{1}{(s+2)^2}+\frac{1}{s+2}\right\}$ (c) $H(s)=\frac{1}{(s+3)^2}$
6.4	(a) $F(s)=\frac{s+2}{(s+2)^2+4}+\frac{1}{(s+3)^3}$ (b) $F(s)=\frac{s^2+8s+115}{(s^2+6s+109)^2}$ (c) $G(s)=\frac{1}{(s+4)^2}+\frac{(s+4)e^{-s}}{(s+3)^2}$ (d) $F(s)=e^{-3}\cdot\frac{2e^{-s}}{(s+3)^2+4}$
6.5	(a) $G(s)=\frac{s+3}{(s+3)^2+10^2}$ (b) $F(s)=3+\frac{2s}{(s+5)^3}$ (c) $F(s)=\frac{s+2}{(s+2)^2+2^2}+\frac{1}{(s+3)^2}$ (d) $F(s)=\frac{1}{s(1+e^{-s})}$
6.6	(a) $G(s)=\frac{1}{s(1+e^{-s})}$ (b) $F(s)=\frac{1-e^{-s}}{(1+e^{-s})s^2}$

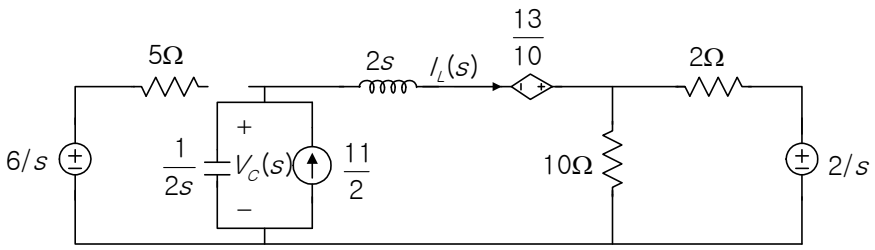
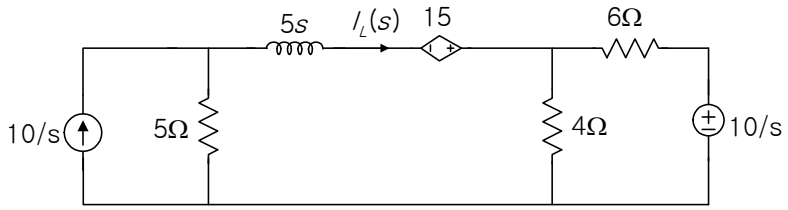
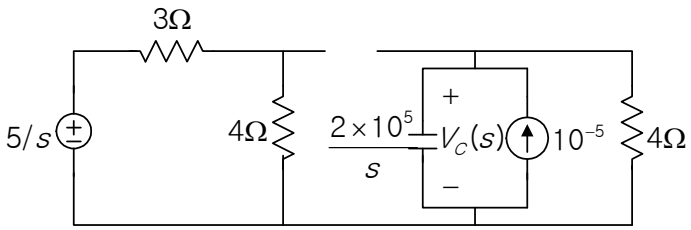
6.7	(a) $F(s)=\dfrac{1-e^{-s}+e^{-2s}-e^{-3s}}{s}$ (b) $F(s)=\dfrac{1-e^{-s}-e^{-3s}+e^{-4s}}{s^2}$
6.8	(a) $f(0)=1,\ \ f(\infty)=4$ (b) $f(0)=0,\ \ f(\infty)=0$ (c) $f(0)=0,\ \ f(\infty)=4$
6.9	(a) $f(t)=(3-5e^{-t}+2e^{-2t})u(t)$ (b) $f(t)=(1-e^{-(t-2)})u(t-2)$ (c) $f(t)=\left(2-\dfrac{7}{3}e^{-t}+\dfrac{1}{3}e^{-4t}\right)u(t)$ (d) $f(t)=\{3-4e^{-t}+e^{-3t}\}u(t)-\{3-4e^{-(t-3)}+e^{-3(t-3)}\}u(t-3)$
6.10	(a) $f(t)=\{4-(4-3t)e^{-t}\}u(t)$ (b) $f(t)=(1-t)e^{-t}\cdot u(t)$ (c) $f(t)=\{11e^{-t}-(8+20t)e^{-2t}\}u(t)$ (d) $f(t)=\{e^{-2t}+(1-5t)e^{-3t}\}u(t)$
6.11	(a) $f(t)=\left(\dfrac{1}{2!}t^2+\dfrac{1}{3!}t^3\right)e^{-t}\cdot u(t)$ (b) $f(t)=\{-3(8-3t)e^{-t}+6(4+3t)e^{-2t}\}u(t)$ (c) $f(t)=\left\{\dfrac{5}{8}e^{-t}-\dfrac{41}{8}e^{-5t}+\dfrac{1}{2}(9-17t)e^{-3t}\right\}u(t)$ (d) $f(t)=\left\{\dfrac{1}{27}+\left(\dfrac{1}{27}+\dfrac{8}{9}t-\dfrac{2}{3}t^2\right)e^{-3t}\right\}u(t)$
6.12	(a) $f(t)=\{2e^{-t}-2(\cos 2t+\sin 2t)e^{-2t}\}u(t)$ (b) $f(t)=\{2-3e^{-t}+(\cos 3t+\sin 3t)e^{-2t}\}u(t)$ (c) $f(t)=\dfrac{1}{2}\{e^{-t}(3\sin t-\cos t)+e^{-2t}(\cos 2t-\sin 2t)\}\cdot u(t)$ (d) $f(t)=\{3(-2+t)e^{-t}+6(\cos 2t+\sin 2t)e^{-2t}\}u(t)$
6.13	(a) $i(t)=2e^{-5t}\cdot u(t)$ (b) $i(t)=\dfrac{1}{10}(1-e^{-10t})\cdot u(t)$ (c) $i(t)=\dfrac{2}{5}(1+4e^{-5t})\cdot u(t)$ (d) $i(t)=\dfrac{1}{16}(-1+4t+81e^{-4t})\cdot u(t)$
6.14	(a) $v(t)=3(-1+4t+e^{-4t})u(t)$ (b) $v(t)=\dfrac{1}{5}\left\{e^{-2t}-\cos 4t+\dfrac{1}{2}\sin 4t\right\}u(t)$ (c) $v(t)=\dfrac{5}{4}\{-e^{-4t}+(\cos 2t+\sin 2t)e^{-2t}\}\cdot u(t)$

6.15	(a) $v(t)=\frac{2}{3}\left(5e^{-t}-2e^{-4t}\right)\cdot u(t)$ (b) $i(t)=(1+3t)e^{-2t}\cdot u(t)$ (c) $i(t)=2(\cos 2t+\sin 2t)e^{-t}\cdot u(t)$ (d) $v(t)=5(1-3t)e^{-3t}\cdot u(t)$
6.16	(a) $v(t)=\left(-15+12t+16e^{-t}-e^{-4t}\right)u(t)$ (b) $v(t)=2\left\{1-(1+2t)e^{-2t}\right\}u(t)$ (c) $i(t)=\left\{e^{-3t}-(\cos t-2\sin t)e^{-t}\right\}u(t)$ (d) $v(t)=\frac{1}{5}(3\sin 3t+2\sin 2t)u(t)$
6.17	(a) $i(t)=\frac{1}{4}\left\{(-3+2t)e^{-t}+12e^{-2t}-5e^{-3t}\right\}u(t)$ (b) $v(t)=\frac{1}{25}\left\{(28-5t)e^{-t}-3\cos 2t+4\sin 2t\right\}u(t)$ (c) $i(t)=(\cos t+8\sin t)e^{-2t}$ (d) $i(t)=\left\{3-(2\cos t+\sin t)e^{-t}\right\}u(t)$

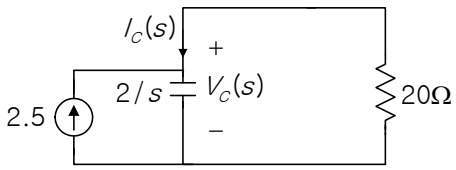
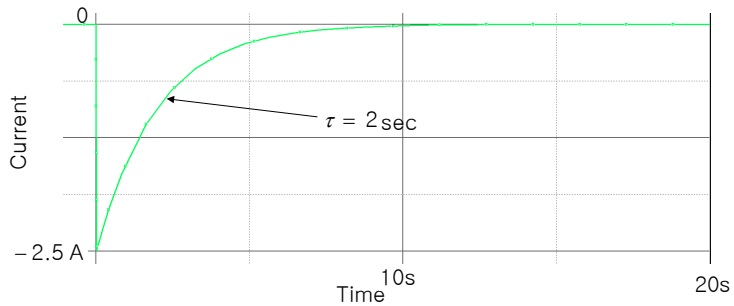
Chapter 07

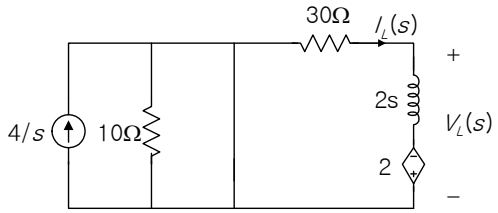
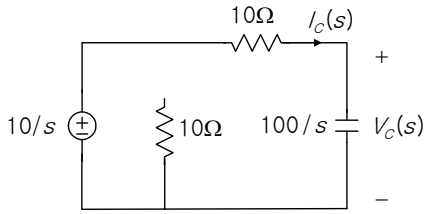
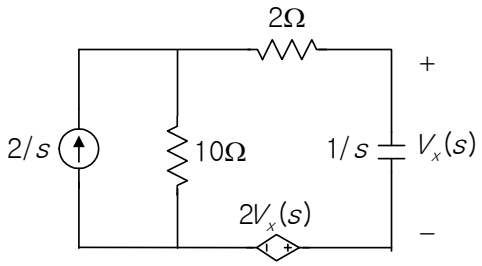
번호	답
7.1	i) $0 \leqq t \leqq 2\mu s \quad v(t) = 2.5 \times 10^8 t^2$ ii) $2\mu s \leqq t \leqq 6\mu s \quad v(t) = 1.5 \times 10^3 t - 1.25 \times 10^8 t^2 - 1.5 \times 10^{-3}[\mathrm{V}]$ iii) $t \geqq 6\mu s \quad v(t) = 3[\mathrm{mV}]$
7.2	(a) i) $t \leqq 0 \quad v(t) = 10[\mathrm{V}]$ ii) $0 \leqq t \leqq 5ms \quad v(t) = 2 \times 10^3 t + 10[\mathrm{V}]$ iii) $t \geqq 5ms \quad v(t) = 20[\mathrm{V}]$ (b) $p_s(t) = 0$
7.3	(a) i) $0 \leqq t \leqq 3\mu s \quad v(t) = \frac{50}{3}[\mathrm{V}]$ ii) $3\mu s \leqq t \leqq 6\mu s \quad v(t) = -\frac{50}{3}[\mathrm{V}]$ (b)  (b)
7.4	i) $t \leqq 0 \quad i(t) = 0$ ii) $0 \leqq t \leqq 3ms \quad i(t) = \frac{10^6}{6} t^2$ iii) $3ms \leqq t \leqq 6ms \quad i(t) = 10^3 t - 1.5$ iv) $6ms \leqq t \leqq 9ms \quad i(t) = 3 \times 10^3 t - \frac{10^6}{6} t^2 - 18 + 6 + 4.5 = 3 \times 10^3 t - \frac{10^6}{6} t^2 - 7.5$ v) $t \geqq 9ms \quad i(t) = 6[\mathrm{A}]$

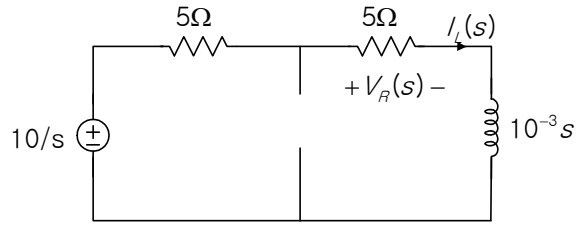
7.5	
7.6	i) $t \leqq 0 \quad p(t) = 0$ ii) $0 < t < 1s \quad p(t) = \frac{1}{5}t$[W] iii) $1s \leqq t \leqq 2s \quad p(t) = 0.2(t-1)$[W] iv) $t \geqq 2s \quad p(t) = 0$
7.7	$C_{eq} = \frac{18}{11}[\mu\text{F}]$
7.8	$L_{eq} = 3[\text{mH}]$
7.9	$C_{eq} = \frac{8}{9}[\mu\text{F}]$
7.10	$L_{eq} = 1.5[\text{mH}]$
7.11	$L_{eq} = 3.6[\text{mH}]$
7.12	$L_{eq} = 10[\text{mH}]$
7.13	$C_{eq} = 3.6[\mu\text{F}]$
7.14	$W_L = 8[\text{J}], \quad W_C = 400[\text{J}]$
7.15	$W_L = 32[\text{J}], \quad W_C = 256[\text{J}]$
7.16	$W_L = 98[\text{J}], \quad W_C = 25[\text{J}]$
7.17	$W = 7.7[\text{nJ}]$
7.18	$W = 252[\mu\text{J}]$
7.19	$V_{eq} = \frac{14}{3}[\text{V}]$
7.20	연결후 저장된 에너지 : $W = \frac{1}{2}C_{eq} \times V_{eq}^2 = \frac{121}{4}\mu J$ 연결함으로 인해 저장에너지가 $15/4[\mu\text{J}]$ 감소함.
7.21	$W = 2[\mu\text{J}]$
7.22	$W - W' = 57[\text{J}]$
7.23	$i_1(t) = 2.4e^{-2t} + 1.6[\text{mA}]$ $i_2(t) = 3.6e^{-2t} - 1.6[\text{mA}]$

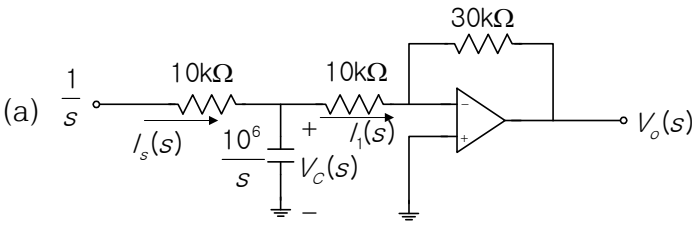
7.24	$v(t)=4.8\sin 4t[mV],\ \ i(t)=50(1-\cos 4t)[\mathrm{mA}]$
7.25	$v(t)=-20\exp(-10^3t)\ \ [\mathrm{mV}],\ \ i_L(t)=5\exp(-10^3t)-3[mA]$
7.26	$v_1(t)=\frac{1}{3}(2e^{-2t}+1),\quad v_2(t)=\frac{4}{3}(e^{-2t}+2)$
7.27	$v_x(t)=\sin 10^3t[\mathrm{V}],\ \ i_o(t)=0.25(1-\cos 10^3t)[\mathrm{A}]$
7.28	$i_x=-16e^{-2t}[\mu\mathrm{A}]$
7.29	$v_c(t)=\frac{2}{9}\{10\exp(-10^3t)-1\},\ \ i_s(t)=-\frac{80}{3}\exp(-10^3t)[\mathrm{mA}]$
7.30	$v_x=4\cos(10^3t)[\mathrm{mV}]$
7.31	
7.32	
7.33	

Chapter 08

번호	답
8.1	(a) $v_C(t)+30\frac{d}{dt}v_C(t)=0$ (b) $i(t)=0.2e^{-t/30}[\mathrm{A}]$ (c) $p_R(t)=2e^{-t/15}$ (d) $W_R=30[\mathrm{J}]$
8.2	(a)  (b) $i_C(t)=-0.25e^{-0.1t}$ (c) $v_C(t)=5e^{-0.1t}$ (d) $W_R=6.25[\mathrm{W}]$
8.3	(a) $W_C=25[\mathrm{J}]$ (b) $v_C(t)+4i_C(t)=0$ (c) $i_C(t)=-5e^{-2t}\ [\mathrm{A}]$ (d) $W_R=25[\mathrm{J}]$
8.4	(a) $i_C(t)=-2.5e^{-t/2}\cdot u(t)[\mathrm{A}]$ (b) 
8.5	(a) $v_C(t)=4[\mathrm{V}],\ i_C(t)=0$ (b) $v_C(t)=4e^{-0.4t}\ [\mathrm{V}],\ i_C(t)=-0.8e^{-0.4t}\ [\mathrm{A}]$

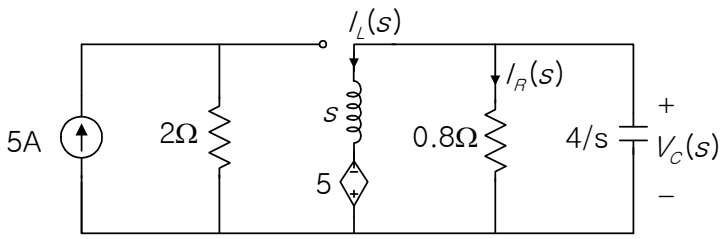
8.6	$t<0$: $i_x(t)=0$, $t>0$: $i_x(t)=-0.8e^{-10t}$ [A]
8.7	(a) $i_L(t)=2$[A] (b) $\frac{d}{dt}i_L(t)+100i_L(t)=0$ (c) $i_L(t)=2e^{-100t}$ [A]
8.8	(a) $i_L(t)=1$[A], $v_L(t)=0$ (b)  (c) $i_L(t)=e^{-15t}$ [A], $v_L(t)=-30e^{-15t}$ [V] (d) $W_R=1$[J]
8.9	(a) $W_L=0.45$[J] (b) $i_L(t)=3e^{-100t}$ [A], $v_L(t)=-30e^{-100t}$ [V] (c) $W_L=\frac{9}{20}$[J]
8.10	(a) $i_L(t)=2e^{-10t}$[A] (b) $i_L(t)=2e^{-10t}\cdot u(t)$[A]
8.11	(a) $v_C(t)=i_C(t)=0$ (b)  (c) $i_C(t)=e^{-10t}$, $v_C(t)=10(1-e^{-10t})$ (d) $W_C=0.5$[J]
8.12	(a) 

	(b) $v_x(t) = 4(1 - e^{-t/4}) \cdot u(t)$
8.13	(a) $i_C(t) = 2e^{-10t}[\mathrm{A}]$ (b) $i_C(t) = 2e^{-10t}[\mathrm{A}]$
8.14	$v_x(t) = \frac{8}{5}e^{-t/5} \cdot u(t)$ [V]
8.15	$v_x(t) = 5 - 2.5e^{-t/2}$ [V]
8.16	$t < 0$: $i_C(t) = 0$, $t > 0$: $i_C(t) = 0.3e^{-0.1t}$ [A]
8.17	$t < 0$: $v_L(t) = 0$, $i_L(t) = 0$ $t > 0$: $i_L(t) = 2(1 - e^{-45t})$ [A], $v_L(t) = 180e^{-45t}$ [V]
8.18	$t < 0$: $i_L(t) = 0$, $v_L(t) = 0$ $t > 0$: $v_L(t) = \frac{20}{3}e^{-10t}$ [V], $i_L(t) = \frac{10}{3}(1 - e^{-t})$ [A]
8.19	(a) $i_L(0_-) = 0$, $v_R(0_+) = 0$ (b) $v_R(t) = 5(1 - 10^{-10^4 t})$ [V] (c)  (d) $v_R(t) = 5(1 - e^{-10^4 t})$[V]
8.20	$t \leqq 0$: $v_o = 0$ $0 < t \leqq 10^{-4}$: $v_o(t) = 10(1 - e^{-10^4 t})$ [V] $t > 10^{-4}$: $v_o(t) = 10 - 10e^{-10^4 t} - 10 + 10e^{-10^4(t - 10^{-4})} = 10(e - 1) \cdot e^{-10^4 t}$
8.21	(a) $v_C(t) = 10$ [V] (b) $10i_C + v_C = 20$ (c) $10\frac{d}{dt}i_C(t) + 5i_C(t) = 0$ (d) $i_C(t) = e^{-0.5t}[\mathrm{A}]$ (e) $v_C(t) = 10 - 10e^{-0.5t}[\mathrm{V}]$
8.22	(a) $v_x(t) = 5 - 2.5e^{-t/2}$ [V] (b) $v_x(t) = 5 - 2.5e^{-0.5t}$ [V]
8.23	$v_L(t) = -30e^{-20t}$ [V]

8.24	$v_L(t) = 10e^{-t}$ [V]
8.25	$i_L(t) = 2 - e^{-1200t}$ [A]
8.26	$v_L(t) = -20e^{-20t} \cdot u(t)$ [V]
8.27	(a) $i_L(t) = 2 - e^{-250t}$[A] (b) $W_L = 72$[mJ]
8.28	$v_o(t) = 2(1 - e^{-2000t}) \cdot u(t)$ [V]
8.29	(a)  (b) $v_o(t) = -1.5(1 - e^{-200t})$ [V] (c) $\frac{d}{dt}v_C(t) + 200v_C(t) = 100$ (d) $\frac{d}{dt}v_o(t) + 200v_o(t) = -300$ (e) $v_C(t) = 0.5(1 - e^{-200t})$ [V], $v_o(t) = -1.5(1 - e^{-200t})$ [V]
8.30	$t < 0$: $v_o(t) = 0$, $0 \leqq t < 1ms$: $v_o(t) = 10^3 t + 1$ [V] $1ms \leqq t < 2ms$: $v_o(t) = -10^3 t + 1$[V], $t \geqq 2ms$: $v_o(t) = 0$
8.31	$v_o(t) = (3 - e^{-20t})u(t) - \{3 - e^{-20(t-0.2)}\}u(t-0.2)$
8.32	$v_o(t) = -4\cos(10^3 t)u(t)$

Chapter 09

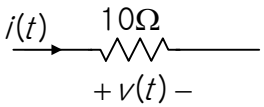
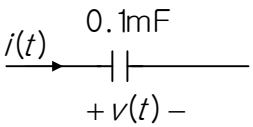
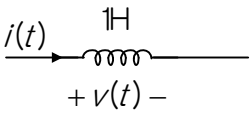
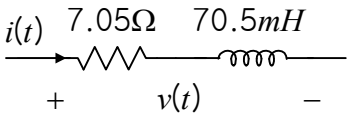
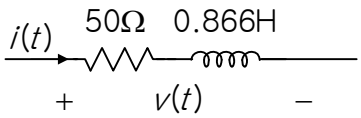
번호	답
9.1	(a) $f(t)=e^{-2t}\cdot \sin 2t$ (b) $h(t)=5(1+2t)\cdot e^{-2t}$ (c) $g(t)=2+e^{-2t}-3e^{-4t}$
9.2	(a) $i(t)=0,\ v(t)=2\mathrm{V}$ (b) $\frac{d^2}{dt^2}v(t)+2\frac{d}{dt}v(t)+v(t)=0$ (c) 임계제동으로 동작함 (d) $v(t)=2(1+t)e^{-t},\quad i(t)=2te^{-t}$
9.3	(a) $i(t)=-50(e^{-20t}-e^{-100t})\ [\mathrm{mA}]$ (b) $v(t)=\frac{5}{4}(5e^{-20t}-e^{-100t})$
9.4	(a) $i(t)=0,\ v(t)=10$ (b) $i(t)=10e^{-t}\cdot \sin t[\mathrm{A}]$ (c) $v(t)=10e^{-t}(\cos t+\sin t)$
9.5	(a) $i(t)=0,\ v(t)=10$ (b) $i(t)=5e^{-2t}\cdot \sin 2t[\mathrm{A}]$ (c) $v(t)=10e^{-2t}\cdot \cos 2t[\mathrm{V}]$
9.6	(a) $v_R(t)=2e^{-10^3t}\sin 10^4t\cdot u(t)\ [\mathrm{V}]$ (b) $v_R(t)\big\vert_{max}=2e^{-0.05\pi}$
9.7	$i_L(t)=3.2t\cdot e^{-20t}[\mathrm{A}]$
9.8	(a) $i(t)=0,\ v(t)=0$ (b) $v(t)=10(1-2e^{-2t}+e^{-4t})[\mathrm{V}]$
9.9	$v(t)=10\left[1-e^{-7.125t}(\cos 7.02t+1.02\sin 7.02t)\right]$
9.10	(a) $i_L(t)=0,\ v_C(t)=0$ (b) $\frac{d^2}{dt^2}v_C(t)+2\frac{d}{dt}v_C(t)+v_C(t)=20$ (c) $v_C(t)=10-10(1+t)e^{-t}$
9.11	(a) $i(t)=2.5\{1-e^{-t}(\cos t+\sin t)\}\cdot u(t)[\mathrm{A}]$ (b) $i(t)\big\vert_{max}=2.5(1+e^{-\pi})$

9.12	$i(t)=\frac{1}{2\sqrt{3}}\{e^{-(4-2\sqrt{3})\times 10^4 t}-e^{-(4+2\sqrt{3})\times 10^4 t}\}$
9.13	(a) $i_L=0,\ v_C(t)=10[\mathrm{V}]$ (b) $i_L(t)=5te^{-t}\ [\mathrm{A}]$
9.14	$v_C(t)=5+15e^{-2t}-5e^{-3t}\ [\mathrm{V}],\ i_L(t)=2.5(1-3e^{-2t}+2e^{-3t})\ [A]$
9.15	(a) $i_L(t)=-1.4e^{-5t}\left(\frac{1}{\sqrt{13}}\sin 5\sqrt{13}\,t\right)\ [\mathrm{A}]$ (b) $R_L=\frac{100}{3}[\Omega]$
9.16	(a) $v(t)=6-8e^{-t}+2e^{-4t}$ (b) $v(t)=12+\{(18e^4+24e^3-6)+(8-32e^3-24e^4)t\}e^{-4t}$
9.17	(a) $i_L(t)=5,\ v_C(t)=0$ (b)  (c) $i_R(t)=-\frac{25}{3}(e^{-t}-e^{-4t})\cdot u(t)\ [\mathrm{A}]$
9.18	(a) $v_C(t)=-20e^{-t}\cdot \sin t\cdot u(t)\ [\mathrm{V}]$ (b) $p_R(t)=100e^{-2t}(1-\cos 2t)$ (c) $W_R=25[\mathrm{J}]$
9.19	(a) $i_L(t)=5,\ v_C(t)=0$ (b) $i_L(t)=5(\sqrt{2}+1)e^{-(2-\sqrt{2})t}+5(1-\sqrt{2})e^{-(2+\sqrt{2})t}$
9.20	(a) $i_L(t)=0,\ v_C(t)=0$ (b) $v_C(t)=\frac{20}{3}(e^{-t}-e^{-4t})u(t)\ [\mathrm{V}],\ i_L(t)=\left(5-\frac{20}{3}e^{-t}+\frac{5}{3}e^{-4t}\right)\cdot u(t)\ [\mathrm{A}]$
9.21	$i_L(t)=5\{1+(1+t)e^{-t}\}\cdot u(t)\ [\mathrm{A}]$
9.22	(a) $i_L(t)=0,\ v_C(t)=0$ (b) $\frac{d^2}{dt^2}i_L(t)+4\frac{d}{dt}i_L(t)+8i_L(t)=40$ (c) 부족제동으로 동작함 (d) $v_C(t)=20e^{-2t}\sin 2t[\mathrm{V}]$

9.23	(a) $i_L(t) = -5,\ v_C(t) = 0$ (b) $i_L(t) = 5 - \frac{10}{3}(4e^{-t} - e^{-4t})$
9.24	(a) $v_C(0^+) = 0,\ i_L(0^+) = 0.1\ [\mathrm{A}],\ i_R(0^+) = 0.16\ [\mathrm{A}]$ (b) $\frac{d}{dt}v_C(t)\Big\|_{t=0^+} = 6\times10^4,\ \frac{d}{dt}i_L(t)\Big\|_{t=0^+} = 0,\ \frac{d}{dt}i_R(t)\Big\|_{t=0^+} = 1.2\times10^3$ (c) $\frac{d^2}{dt^2}i_R(t) + 2\times10^3\frac{d}{dt}i_R(t) + 10^7 i_R(t) = 1.6\times10^6$ (d) $i_R(t) = 0.16 + e^{-10^3 t}\{1.44\cos(3\times10^3 t) + 0.88\sin(3\times10^3 t)\}$
9.25	(a) $i_L(t) = 5 + (2+4t)e^{-2t}\ [\mathrm{A}]$ (b) $v_C(t) = -24t\cdot e^{-2t}\ [\mathrm{V}]$
9.26	$v_1(t) = \frac{15}{2} - \frac{20}{3}e^{-t} - \frac{5}{6}e^{-4t}\ [\mathrm{V}],\ v_2(t) = 5 - \frac{20}{3}e^{-t} + \frac{5}{3}e^{-4t}\ [\mathrm{V}]$
9.27	(a) $i_{L2}(0_+) = 0,\ \frac{d}{dt}i_{L2}(t)\Big\|_{t=0_+} = 10$ (b) $\frac{d^2}{dt^2}i_{L2}(t) + 6\frac{d}{dt}i_{L2}(t) + 4i_{L2}(t) = 0$ (c) $i_{L2}(t) = \sqrt{5}\cdot\{e^{(-3+\sqrt{5})t} - e^{-(3+\sqrt{5})t}\}$
9.28	$v_o(t) = -2e^{-100t}\cdot\sin 100t\ [\mathrm{V}]$
9.29	(a) $\frac{d^2}{dt^2}v_1 + 2\frac{d}{dt}v_1(t) + v_1(t) = 5$ (b) $v_o(t) = 5t\cdot e^{-t}\ [\mathrm{V}]$
9.30	(a) $\frac{d^2}{dt^2}v_o(t) + \frac{100}{9}\frac{d}{dt}v_o(t) + \frac{100}{9}v_o(t) = v_i(t)$ (b) $v_o(0^+) = 0,\ \frac{d}{dt}v_o(t)\Big\|_{t=0^+} = 0$ (c) $v_o(t) = 5 - \frac{45}{8}e^{-10t} + \frac{5}{8}e^{-90t}\ [\mathrm{V}]$

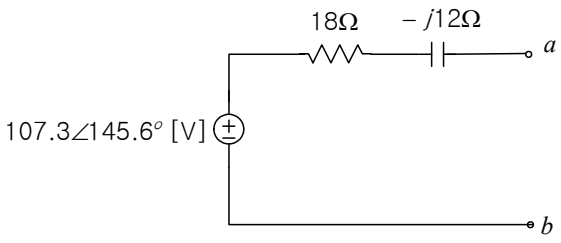
Chapter 10

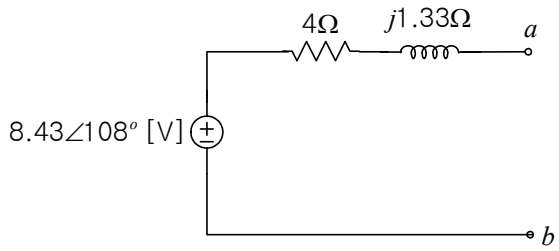
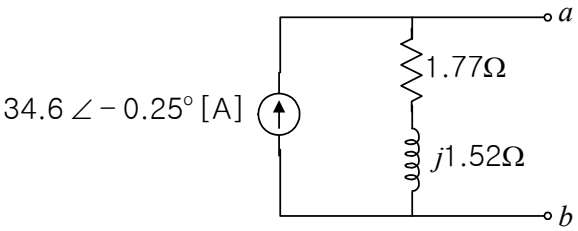
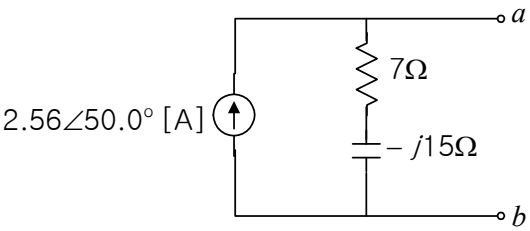
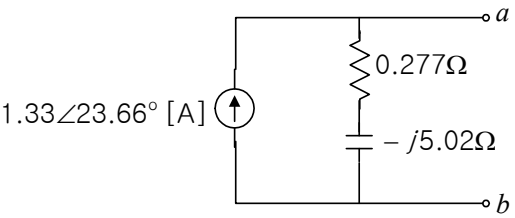
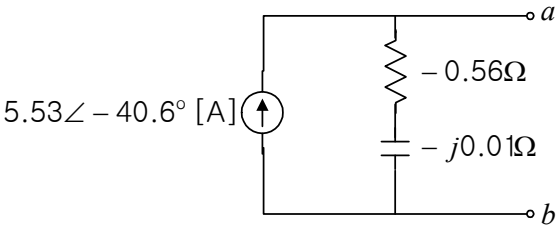
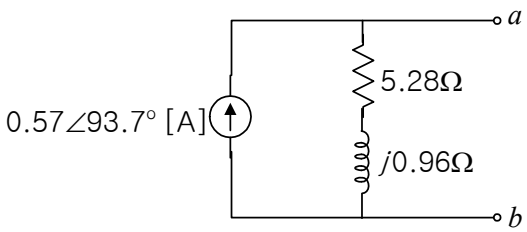
번호	답
10.1	(a) 진폭 : $V_m = 5$ 위상 : $\theta = -83.13°$ 주파수 : $\omega = 10rad/s$ (b) 진폭 : $V_m = 14.5$ 위상 : $\theta = 70°$ 주파수 : $\omega = 1krad/s$ (c) 진폭 : $V_m = \sqrt{5}$ 위상 : $\theta = 165°$ 주파수 : $\omega = 100rad/s$
10.2	(a) $v_1(t)$가 $v_2(t)$보다 $30°$ 빠르다. (b) $v_1(t)$가 $v_2(t)$보다 $120°$ 빠르다. (c) $i_1(t)$가 $i_2(t)$보다 위상이 $30°$ 빠르다.
10.3	(a) $v(t) = 10\sqrt{2}\cos(t+45^o)$, $i(t) = 5\sqrt{2}\cos(t-45^o)$ (b) $v(t) = 25\sqrt{2}\cos(4t-45^o)$, $i(t) = \frac{5\sqrt{5}}{4}\cos(4t-63.4^o)$
10.4	(a) $\boldsymbol{V} = 2\sqrt{2}+j2\sqrt{2}$ (b) $\boldsymbol{V} = -20+j20\sqrt{3}$ (c) $\boldsymbol{I} = 5-j2\sqrt{3}$ (d) $\boldsymbol{I} = j\sqrt{2}$ (e) $\boldsymbol{I} = 5(1+\sqrt{3})-j5(1+\sqrt{3})$ (f) $\boldsymbol{V} = \left(5-\frac{\sqrt{3}}{20}\right)+j\left(5\sqrt{3}-\frac{1}{20}\right)$ (g) $\boldsymbol{I} = \sqrt{3}+j3$
10.5	(a) $v(t) = 40\cos(10t-30^o)$ (b) $v(t) = 19.9\cos(10t+15.98^o)$ (c) $i(t) = \cos(20t-45^o)$ (d) $i(t) = 5\cos(20t+53.13^o)$ (e) $v(t) = 19.32\cos(4t+15^o)$ (f) $v(t) = 1.17\cos(100t+5.9^o)$
10.6	(a) $v(t) = 0.329\cos(10t-80.5^o)$ (b) $v(t) = 9.58\sin(10t-43.3^o)$ (c) $v(t) = 0.60\cos(10t-87.7^o)$ (d) $v(t) = 0.8\cos(2t-98.13^o)$ (e) $v(t) = 0.745\cos(5t-6.56^o)$
10.7	(a) $\frac{d^2}{dt^2}v_o(t)+20\frac{d}{dt}v_o(t)+\frac{500}{3}v_o(t) = 10\frac{d}{dt}v_s(t)$ (b) $v_o(t) = 0.47\cos(10t+18.4^o)$

10.8	(a) $\frac{d^2}{dt^2}i_L(t)+2\times10^3\frac{d}{dt}i_L(t)+3\times10^6 i_L(t)=5\times10^6\cos10^3t$ (b) $i_L(t)=1.77(\cos10^3t-45^o)$
10.9	$\boldsymbol{I}_o=4.60-j0.827$
10.10	$v_o(t)=5\cos(2t+90^o)$, $i(t)=2.5\cos2t$
10.11	$v_o(t)=1.25\cos(10t+38.7^o)$
10.12	$v_o(t)=3.92\cos(100t+124^o)$
10.13	$v(t)=5\cos(10^3t)$
10.14	$\boldsymbol{I}_o=-j10=10\angle-90^o$
10.15	$i(t)=\sqrt{2}\cos(10t-45^o)$, $v_o(t)=\sqrt{2}\cos(10t+45^o)$
10.16	(a)  (b)  (c)  (d)  (e) 
10.17	(a) $Z_{in}=0.5+j0.5$ (b) $Z_{in}=4-j2$
10.18	$Z_{in}=150-j80$
10.19	(a) $Z_{in}=6-j8[\Omega]$ (b) $Z_{in}=15-j5[\Omega]$

10.20	(a) $i_s(t) = 0.284\cos(10t - 71.6°)[\mathrm{A}]$ (b) $I_s = 2.5$
10.21	$v_o(t) = 2.5\cos(100t + 90°)$
10.22	$i_o(t) = \sqrt{2}\cos(2t + 45°)$
10.23	$I_S = 8 - j4$
10.24	$V_s = 4 + j4$
10.25	$Z = 4 + j4[\Omega]$

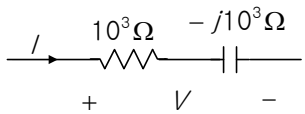
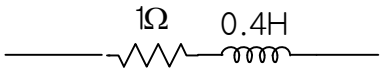
Chapter 11

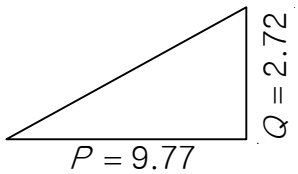
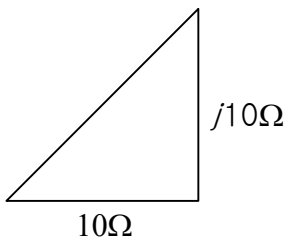
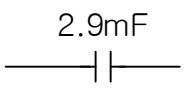
번호	답
11.1	$v_o(t) = 15.8\cos(10t + 26.6)$
11.2	$v_o(t) = 20.1\cos(t - 1.2^o)$
11.3	$v_o(t) = 2.74\cos(t - 8.34^o)$
11.4	$I_o = -0.90 + j1.07$
11.5	$\boldsymbol{I} = 5.74 + j5.44$
11.6	$\boldsymbol{I} = 1.42 + j0.34$
11.7	$\boldsymbol{V}_o = -44 - j12$ [V]
11.8	$\boldsymbol{V}_o = 6(1 + j)$ [V]
11.9	$v_o(t) = 2.2\cos(4t - 174^o)$ [V]
11.10	$\boldsymbol{I}_o = 3.05\angle -165.9^o$ [A]
11.11	$\boldsymbol{I}_o = 7.6\angle -59.2^o$ [A]
11.12	$\boldsymbol{V}_o = 3.58\angle 80^o = 0.62 + j3.5$
11.13	$\boldsymbol{I}_o = 4.5\angle 138^o$
11.14	$i_x(t) = 4.01\cos(2t - 38.9^o)$
11.15	$v_o(t) = 6.49 \cdot \cos(4t - 36.3^o)$ [V]
11.16	$i_o = 4 + 0.49\cos(2t - 50.9^o) + 0.49\cos(4t - 119^o)$
11.17	$i_o \equiv 50 + 120 \cdot \cos(2 \times 10^3 t + 122^o)$ [mA]
11.18	$v_o(t) = 3.61\cos(10^5 t - 40.6^o)$
11.19	$\boldsymbol{V}_o = \frac{30}{17} - j\frac{50}{17}$
11.20	

11.21	
11.22	$\boldsymbol{V} = (10 + j5) \cdot \boldsymbol{I} + 5.59 \angle 18.4^{o}$
11.23	
11.24	
11.25	
11.26	
11.27	

11.28	$v_o(t) = 1.79\cos(10^3 t - 153^o)$
11.29	$v_o(t) = 1.41\cos(10^3 t - 129^o) + 71.1\cos(100t + 50.7^o)$
11.30	$\boldsymbol{Z}_{in} = 15(1-j)\times 10^3 \ [\Omega]$
11.31	$\dfrac{\boldsymbol{V}_o}{\boldsymbol{V}_s} = \dfrac{R_2 + R_3}{R_3} \cdot \dfrac{(1 + j\omega(R_2 // R_3)C_2}{(1 + j\omega R_1 C_1) \cdot 1 + j\omega R_2 C_2)}$

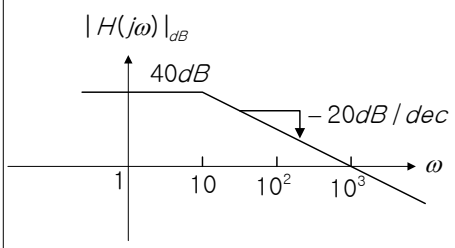
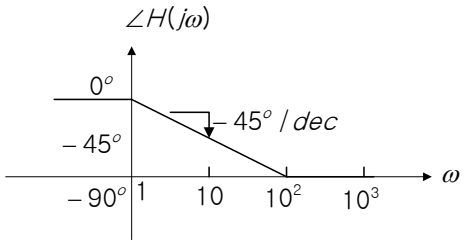
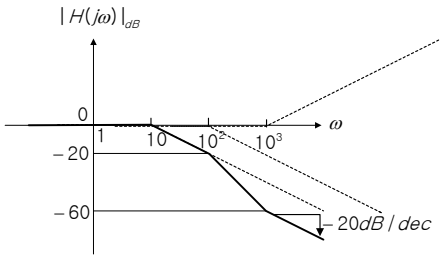
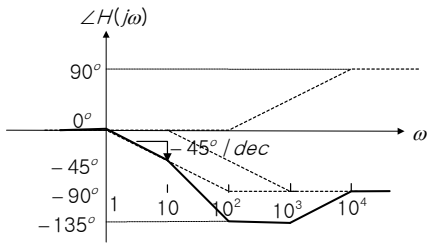
Chapter 12

번호	답
12.1	(a) $p(t)=\frac{1}{2}V_m I_m\{\cos\theta_i+\cos(2\omega t+\theta_i)\}$ (b) $p(t)=50(1+\sin 20t)$
12.2	(a) $p(t)=4.1\cos(4t-109.6^o)$[W] (b) $p(t)=3.175\cos(8t)$ [W]
12.3	$P_{40\Omega}=22.5$ [W]
12.4	$R=6.13[\Omega]$
12.5	$P=51.3$ [W]
12.6	(a)  (b) $P=25$[mW]
12.7	$P=0$
12.8	$P=50$[W]
12.9	$P_{\max}=53.6$[W]
12.10	$R_L=\sqrt{34}[\Omega]$
12.11	(a) $Z_L=\frac{3}{2}+j\frac{1}{6}$, $P_{\max}=2.31$[W] (b) $\boldsymbol{Z}_L=2-j$, $P_{\max}=10$[W]
12.12	
12.13	$R=6.33[\Omega]$
12.14	(a) $V_{rms}=\frac{2}{\sqrt{3}}$[V] (b) $V_{rms}=\sqrt{7/6}$ [V]
12.15	(a) $I_{rms}=10$ [mA] (b) $I_{rms}=5$[mA]
12.16	(a) $\boldsymbol{S}=220\angle -30^o$ [VA], $P=110\sqrt{3}$ [W], $Q=-220$ [VAR],

	$pf = \frac{\sqrt{3}}{2}$(leading, 진상) (b) $\boldsymbol{S} = 121\angle 60^o$ [VA], $P = \frac{121}{2}$ [W], $Q = \frac{121\sqrt{3}}{2}$[VAR], $pf = 0.5$(lagging, 지상) (c) $\boldsymbol{S} = 800\angle 60^o$ [VA], $P = 400$ [W], $Q = 400\sqrt{3}$ [VAR], $pf = 0.5$(lagging, 지상) (d) $\boldsymbol{S} = 6.4\times 10^3\angle 30^o$ [VA], $P = 3.2\times\sqrt{3}$ [kW], $Q = 3.2$ [kVAR], $pf = \frac{\sqrt{3}}{2}$(lagging, 지상) (e) $\boldsymbol{S} = 45\angle -30^o$ [VA], $P = 22.5\sqrt{3}$ [W], $Q = -22.5$ [VAR], $pf = \frac{\sqrt{3}}{2}$(leading, 진상)
12.17	(a) $\boldsymbol{S} = 260 + j100$[VA] (b) $\boldsymbol{S} = 300 + j100\sqrt{27}$[VA] (c) $\boldsymbol{S} = 1.21\angle 30^o$[kVA] (d) $\boldsymbol{S} = \frac{4}{14} + j\frac{6}{13}$[kVA] (e) $\boldsymbol{S} = 1.6 - j1.43$[kVA]
12.18	$\boldsymbol{S} = j5.52$ [kVA]
12.19	$pf = 0.16$(lagging, 지상), $P_{전원} = 29.1$ [W]
12.20	$I_m = 53.5$ [A], $S = 8.33$ [kVA]
12.21	$S = 40.6\angle -81.9^o$[VA]
12.22	
12.23	$\boldsymbol{V}_o = 40.5\angle -18.9^o$ [V_{rms}]
12.24	 , $pf = \cos 45^o = 0.707$(지상)
12.25	

12.26	(a) $pf = \frac{1}{\sqrt{2}}$, 지상(lagging) (b) $pf_{total} = \frac{1}{\sqrt{5}}$(진상)
12.27	(a) $\boldsymbol{S}_{전원} = 880 + j348$ [VA] (b) $pf = 0.93$(지상) (c) $C = 194$ [μF]

Chapter 13

번호	답
13.1	(a) $T(j\omega)=\dfrac{1}{1+j\omega RC}$ (b) $T(j\omega)=\dfrac{j\omega L}{R+j\omega L}$
13.2	(a) $T(s)=\dfrac{R+sL}{2R+s(R^2C+L)+s^2RLC}$ (b) $T(s)=\dfrac{s^2RLC}{R+sL+s^2RLC}$
13.3	(a) $H(j\omega)=\dfrac{100\omega}{100\omega+j(50\omega^2-2)}$ (b) $H(j\omega)=\dfrac{8\omega^2}{(7\omega^2+4)-j14\omega}$
13.4	(a)  [크기에 대한 보데선도]  [위상에 대한 보데선도] (b)  [크기에 대한 보데선도]  [위상에 대한 보데선도]

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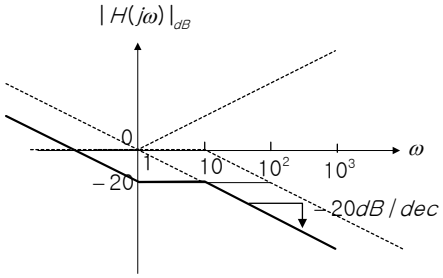

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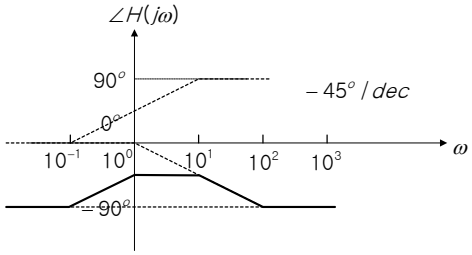
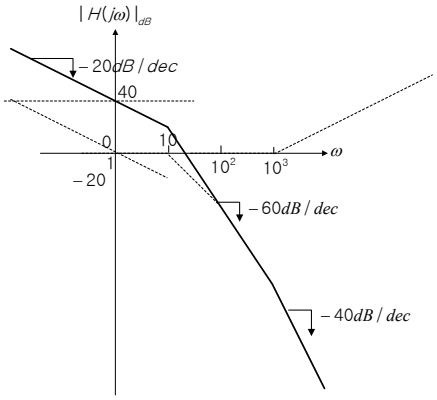
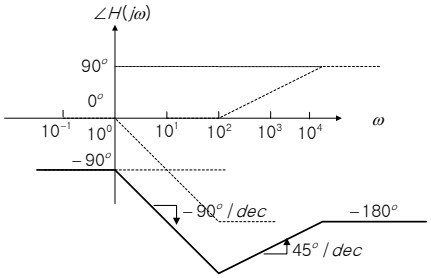


[위상에 대한 보데선도]

(d)



[크기에 대한 보데선도]



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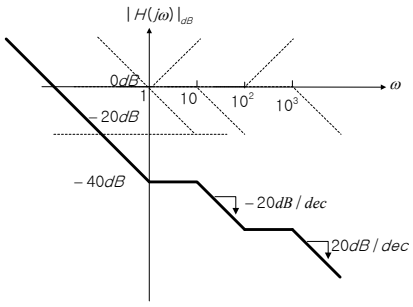
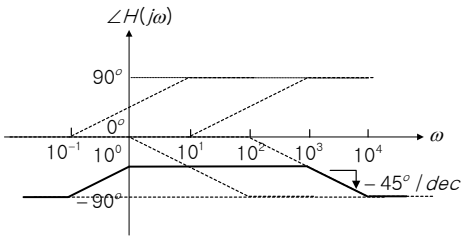
13.5

(a)

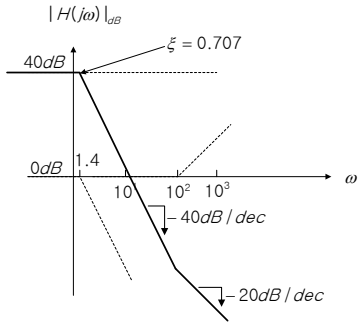


크기에 대한 보데선도

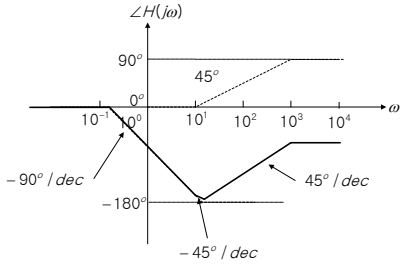


위상에 대한 보데선도

(b)

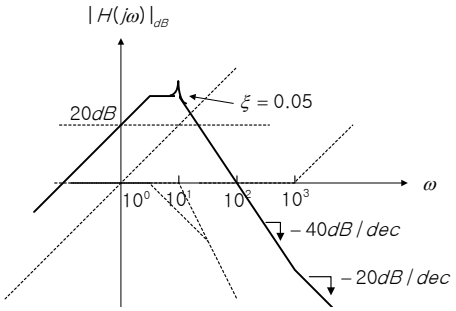


크기에 대한 보데선도

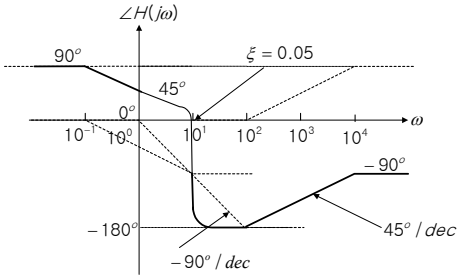


위상에 대한 보데선도

(c)



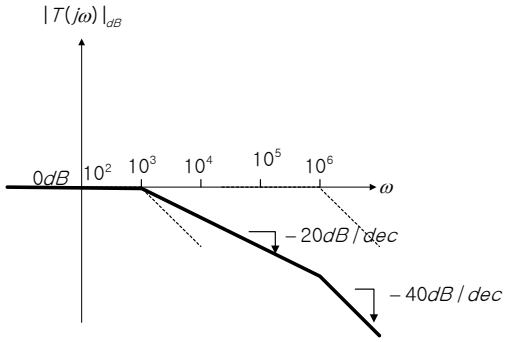
크기에 대한 보데선도



위상에 대한 보데선도

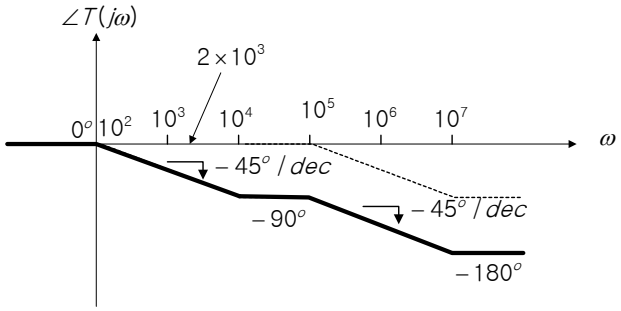
13.6	(a) $T(s) = \dfrac{10(1+s/10)}{(1+s/10^2)(1+s/10^3)}$ (b) $T(s) = \dfrac{s^2(1+s/10^4)}{(1+s/10)^2(1+s/10^2)}$
13.7	$T(s) = \dfrac{10^3(1+s/10)}{s(1+s/10^3)}$
13.8	$T(s) = \dfrac{1}{s(1+s/10^3)}$
13.9	$T(s) = \dfrac{1+s/10^5}{(1+s/10)(1+s/10^2)}$
13.10	$\omega_o = 5\times 10^4[rad],\ Z_{in}(j\omega_o/2) = 10^3 + j480[\Omega],\ Z_{in}(j2\omega_o) = 10^3 + j1995[\Omega]$
13.11	(a) $T(s) = \dfrac{1}{(1+s/10^3)(1+s/10^6)}$ (b) 영점은 없음, 극점 : $s = -10^3,\ -10^6$

(c)



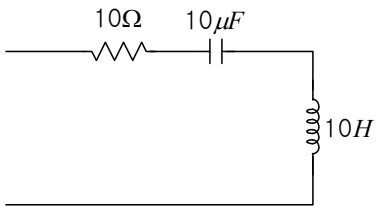
크기에 대한 보데선도

(d)



위상에 대한 보데선도

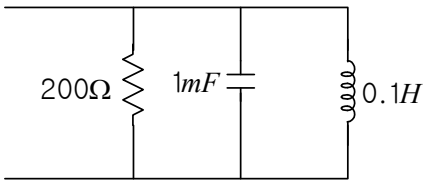
13.12



13.13

$\omega_o = 0.786$ [rad/s]

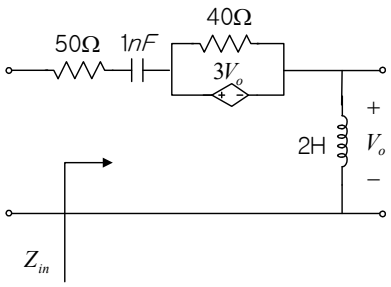
13.14



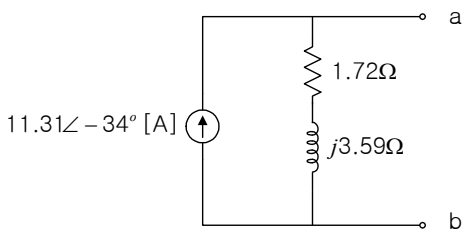
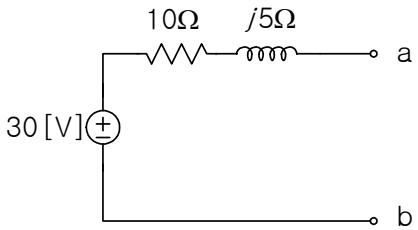
13.15

(a) $\omega_o = 4.84\times10^3$[rad/s]

(b) $\omega_o = \sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$

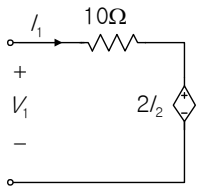
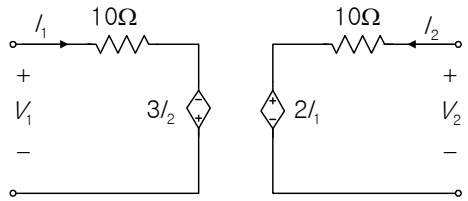
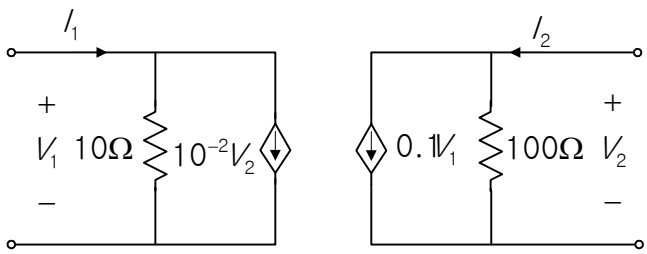
13.16	$\omega_o = \sqrt{3}\,[\mathrm{rad/s}]$
13.17	$\omega_o = \sqrt{\dfrac{1}{LC - R_2^2 C^2}}$
13.18	(a) $\omega_o = 0.5\,[\mathrm{rad/s}]$ (b) $Q = 0.5$
13.19	(a) $\omega_o = 1.58\,[\mathrm{rad/s}]$, $Q = 0.2$, $B = 8\,[\mathrm{rad/s}]$ (b) $\omega_o = 5\times 10^3\,[\mathrm{rad/s}]$, $Q = 20$, $B = 250\,[\mathrm{rad/s}]$
13.20	(a) 고역통과필터, $\omega_c = 1000\,[\mathrm{rad/s}]$ (b) 저역통과필터, $\omega_c = 1000\,[\mathrm{rad/s}]$
13.21	(a) 저역통과필터, $\omega_c = 1000\,[\mathrm{rad/s}]$, (b) 고역통과필터, $\omega_c = 1000\,[\mathrm{rad/s}]$
13.22	$R = 0.42\,[\Omega]$, $L = 0.21$ [mH], $C = 40\,[\mu\mathrm{F}]$의 직렬회로
13.23	$\omega_o = \sqrt{2}$, $B = 2\,[\mathrm{rad/s}]$
13.24	$\omega_o = 1 rad/s$, $\omega_1 = 0.303 rad/s$, $\omega_2 = 3.30 rad/s$ 인 대역통과필터
13.25	$\lim_{s\to 0} H(s) = 0$, $\lim_{s\to\infty} H(s) = 0$, 대역통과필터
13.26	(a) $T(s) = \left(1 + \dfrac{R_1}{R_2}\right) \cdot \dfrac{sR_iC_i}{1 + sR_iC_i}$, 고역통과필터 (b) $T(s) = \dfrac{1}{1 + s(R_1 + R_2)C_2 + s^2 R_1 R_2 C_1 C_2}$, 저역통과필터
13.27	(a) $\boldsymbol{Z}_{in}(j\omega) = 5 + j(8\omega - 10^7/\omega)$ (b)  (c) $\boldsymbol{Z}_{in}(j\omega) = 50 + j(8\omega - 10^9/\omega)$
13.28	(a) $T(s) = \dfrac{s}{1+s}$ (b) $K_m = 10^3$, $R = 1\,[\mathrm{k}\Omega]$

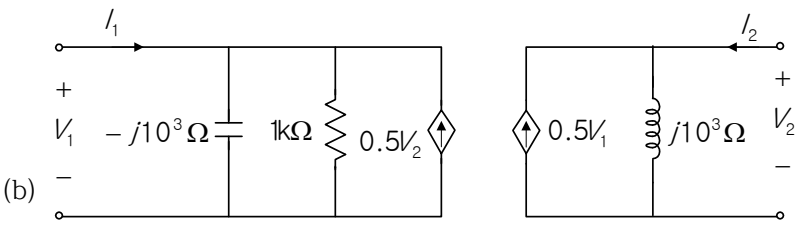
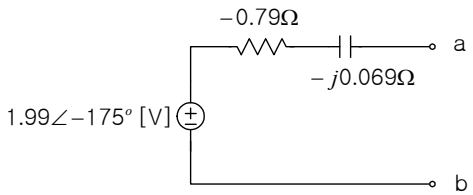
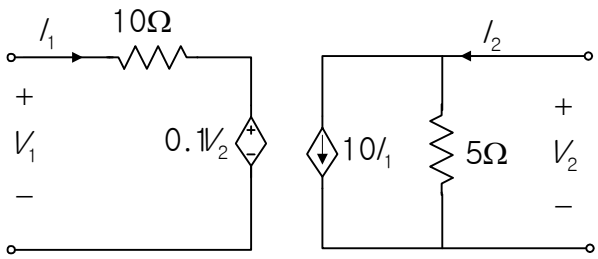
Chapter 14

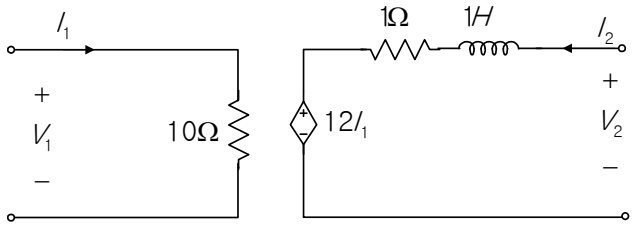
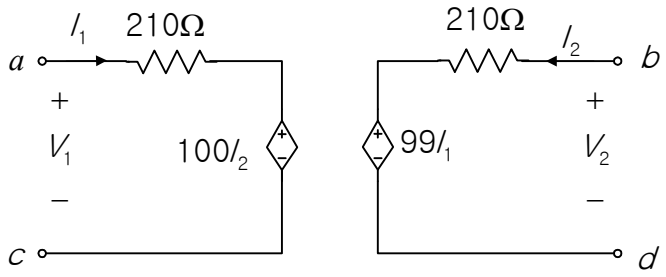
번호	답
14.1	$Z_{in} = 1.94 - j0.06[\Omega]$
14.2	(a) $L_{eq} = 36[\mathrm{H}]$ (b) $L_{eq} = \frac{100}{13}[\mathrm{H}]$
14.3	$\boldsymbol{V}_1 = (R_1 + j\omega L_1) \cdot \boldsymbol{I}_1 + j\omega M \cdot \boldsymbol{I}_2 \quad \boldsymbol{V}_2 = j\omega M \cdot \boldsymbol{I}_1 + (R_2 + j\omega L_2) \cdot \boldsymbol{I}_2$
14.4	$v_o(t) = 111.5\cos(10t - 99.5^o)$ [V]
14.5	$v_o(t) = 3.92\cos(2t - 71^o)$ [V]
14.6	$\boldsymbol{V}_1 = 3.98 \angle 34^o$, $\boldsymbol{V}_2 = 4.14 \angle -39^o$
14.7	
14.8	
14.9	$v_o(t) = 1.12\sin(2t - 33.4^o)$
14.10	$W_t = 0.61$ [J]
14.11	$W_t = 28.3$ [μJ]
14.12	$P_{10\Omega} = 15.14[\mathrm{W}]$
14.13	$\boldsymbol{Z}_{in} = 23.92 - j6.49$
14.14	$\boldsymbol{Z}_{in} = 0.088 + j8.67[\Omega]$
14.15	$\boldsymbol{I}_1 = 74 \angle 42.0^o$ [mA], $\boldsymbol{I}_2 = 222 \angle 42.0^o$ [mA]

14.16	$\boldsymbol{V}_1 = -5.27,\ \boldsymbol{V}_2 = -1.32[\mathrm{V}]$
14.17	$\boldsymbol{V}_o = 24$
14.18	$\boldsymbol{S} = (74 - j34) \times 10^3[\mathrm{VA}]$
14.19	$n = 0.485$
14.20	$\boldsymbol{Z}_{in} = 5.7 - j1.9\ [\Omega]$
14.21	$\boldsymbol{V}_o = 2.92 \angle 15.26^o\ [\mathrm{V}]$
14.22	$P_L = 44.3[\mathrm{kW}]$
14.23	$\boldsymbol{I}_1 = 0.83 \angle -88.7^o\ [\mathrm{A}],\ \boldsymbol{I}_2 = 0.454 \angle -157^o\ [\mathrm{A}]$
14.24	$\boldsymbol{Z}_{eq} = 2 + j$
14.25	$P_{2\Omega} = 367[\mathrm{W}],\ P_{5\Omega} = 1.81[\mathrm{W}],\ P_{10\Omega} = 14.5[\mathrm{W}]$
14.26	$\boldsymbol{I}_1 = 0.017 \angle -11.63^o\ [\mathrm{A}],\ \boldsymbol{I}_2 = 0.083 \angle -11.63,\ P_L = 0.069[\mathrm{W}]$
14.27	$\boldsymbol{Z}_{in} = 1.6 + j1.6\ [\Omega]$
14.28	$P_L = 9.59[\mathrm{W}]$

Chapter 15

번호	답
15.1	(a) $z_{11}=6+j2\ [\Omega],\ z_{12}=2+j2\ [\Omega],\ z_{21}=2+j2\ [\Omega],\ z_{22}=2-j2\ [\Omega]$ $y_{11}=\frac{1}{8}[\mho],\ y_{21}=-j\frac{1}{8}[\mho],\ y_{12}=-j\frac{1}{8}\ [\mho],\ y_{22}=\frac{1}{8}-j\frac{1}{4}[\mho]$ (b) $z_{11}=\frac{150}{7}\ [\Omega],\ z_{12}=-\frac{130}{7}\ [\Omega],\ z_{21}=z_{22}=\frac{10}{21}\ [\Omega]$ $y_{11}=25[m\mho],\ y_{21}=-25[m\mho],\ y_{12}=0.975\ [\mho],\ y_{22}=4.5[\mho]$ (c) $z_{11}=\frac{10}{3}\ [\Omega],\ z_{12}=\frac{5}{3}\ [\Omega],\ z_{21}=\frac{5}{3}[\Omega],\ z_{22}=\frac{10}{3}[\Omega]$ $y_{11}=\frac{2}{5}[\mho],\ y_{12}=-\frac{1}{5}[\mho],\ y_{21}=-\frac{1}{5}[\mho],\ y_{22}=\frac{1}{5}[\mho]$ (d) $z_{11}=5\ [\Omega],\ z_{12}=j5\ [\Omega],\ z_{21}=-j5[\Omega],\ z_{22}=5(1-j2)[\Omega]$ $y_{11}=0.1[\mho],\ y_{21}=j0.1[\mho],\ y_{12}=j0.1\ [\mho],\ y_{22}=0.1[\mho]$
15.2	(a) $z_{11}=-10^3[\Omega],\ z_{12}=10[\Omega],\ z_{21}=-998[\Omega],\ z_{22}=30[\Omega]$ (b) $z_{11}=\frac{400}{39}[\Omega],\ z_{12}=-\frac{20}{39}[\Omega],\ z_{21}=-\frac{100}{39}[\Omega],\ z_{22}=\frac{200}{39}[\Omega]$
15.3	(a)  (b) 
15.4	$\boldsymbol{S}_{전원}=268+j38.3[\mathrm{VA}]$
15.5	$z_{11}=20.3-j4.8\ [\Omega],\ z_{12}=2.28-j0.715\ [\Omega],\ z_{21}=0.57-j0.18\ [\Omega],\ z_{22}=5.54+j0.142\ [\Omega]$
15.6	(a) 

	(b) 
15.7	(a) $\boldsymbol{y}_{11}=\frac{2}{21}[\mho],\ \boldsymbol{y}_{12}=-\frac{1}{105}[\mho],\ \boldsymbol{y}_{21}=\frac{1}{210}[\mho],\ \boldsymbol{y}_{22}=\frac{1}{105}[\mho]$ (b) $\boldsymbol{y}_{11}=0.1[\mho],\ \boldsymbol{y}_{12}=-1[\mho],\ \boldsymbol{y}_{21}=10[\mho],\ \boldsymbol{y}_{22}=100[\mho]$
15.8	
15.9	(a) $h_{11}=0,\ h_{12}=1,\ h_{21}=-1,\ h_{22}=-j0.2[\mho]$ $g_{11}=j0.2[\mho],\ g_{12}=-1,\ g_{21}=1,\ g_{22}=-j10[\Omega]$ (b) $h_{11}=5-j10[\Omega],\ h_{21}=1,\ h_{12}=-1,\ h_{22}=-j0.1[\mho]$ $g_{11}=\frac{1+j}{10}=0.1+j0.1[\mho],\ g_{12}=0.5+j0.5,\ g_{21}=0.2-j0.2,\ g_{22}=2.5+j2.5[\Omega]$ (c) $h_{11}=\frac{80}{7}[\Omega],\ h_{12}=0,\ h_{21}=\frac{1}{7},\ h_{22}=0.1[\mho]$ $g_{11}=\frac{7}{80}[\mho],\ g_{12}=0,\ g_{21}=\frac{1}{8},\ g_{22}=10[\Omega]$ (d) $h_{11}=6(2-j)[\Omega],\ h_{12}=1.2+j0.4,\ h_{21}=-1.2-j0.4,\ h_{22}=\left(\frac{1}{75}-j\frac{11}{150}\right)[\mho]$ $g_{11}=\frac{2-j11}{150}\ [\mho],\ g_{21}=1.2+j0.4,\ g_{12}=-1.2-j0.4,\ g_{22}=12-j6\ [\Omega]$
15.10	

15.11	
15.12	$R_{in} = -\frac{38}{3}[k\Omega]$
15.13	$V_2 = \frac{20}{7}[\mathrm{V}]$
15.14	(a) $A = \frac{s+1}{s},\ B = 1,\ C = \frac{s^2+s+1}{s},\ D = \frac{1}{1+s}$ $a = s+1,\ b = 1,\ c = \frac{s^2+s+1}{s^2+s},\ d = \frac{s+1}{s}$ (b) $A = \frac{1}{4},\ B = \frac{3}{2},\ C = -\frac{1}{4},\ D = \frac{1}{2}$ $a = 1,\ b = 3,\ c = -0.5,\ d = 0.5$
15.15	(a) $y_{11} = \frac{5}{52}[\mho],\ y_{12} = \frac{1}{52}[\mho],\ y_{21} = -\frac{1}{52}[\mho],\ y_{22} = \frac{5}{52}[\mho]$ (b) $h_{11} = 10.4[\Omega],\ h_{12} = -0.2,\ h_{21} = -0.2,\ h_{22} = 0.1[\mho]$ (c) $A = 5,\ C = 0.5[\mho],\ B = -52[\Omega],\ D = 5$
15.16	(a) $z_{11} = 2010[\Omega],\ z_{12} = -20[\Omega],\ z_{21} = -100[\Omega],\ z_{22} = 1[\Omega]$ (b) $y_{11} = 0.1[\mho],\ y_{12} = 2[\mho],\ y_{21} = 10[\mho],\ y_{22} = 201[\mho]$ (c) $g_{11} = \frac{1}{2010}[\mho],\ g_{12} = \frac{2}{201},\ g_{21} = \frac{10}{9},\ g_{22} = \frac{1}{201}[\Omega]$
15.17	$\frac{V_o}{V_s} = \frac{30}{89}$
15.18	$g_{11} = 0.043[\mho],\ g_{12} = -0.151,\ g_{21} = 0.173,\ g_{22} = -0.938[\Omega]$
15.19	$g_{11} = 84.0[m\mho],\ g_{12} = -0.071,\ g_{21} = 0.071,\ g_{22} = 0.709[\Omega]$
15.20	(a) $z_{11} = 200[\Omega],\ z_{12} = z_{21} = 100[\Omega], z_{22} = 200[\Omega]$ (b) 

	(c) $\frac{V_o}{V_s}=-0.2$
15.21	$h_{11}=5[\Omega],\ h_{12}=h_{21}=0,\ h_{22}=0.2[\mho]$
15.22	$A=\frac{s^3+s^2+2s+1}{s}, \quad B=\frac{2s^3+2s^2+3s+1}{s},$ $C=\frac{s^4+s^3+3s^2+2s+1}{s}, \ D=\frac{2s^4+2s^3+5s^2+3s+1}{s}$