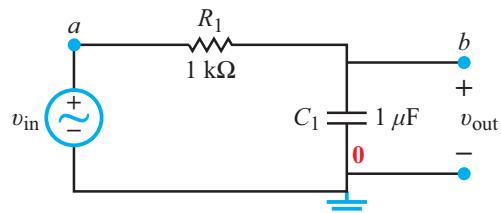
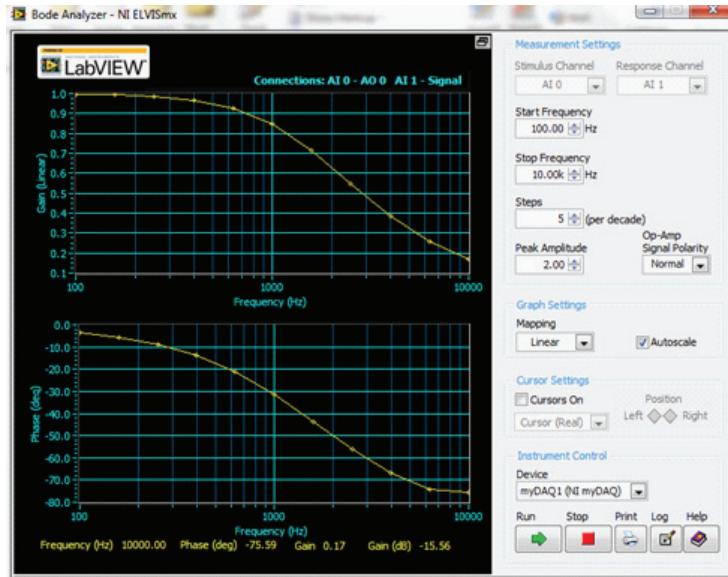


Figure F-30: Bode analyzer.



(a) RC circuit



(b) Bode analyzer display and user interface

Figure F-31: (a) RC circuit and (b) its gain magnitude and phase plots.

APPENDIX

G

Answers to Selected Problems

Chapter 1

1.2 (b) $4 \mu\text{A}$

(d) 390 GV

1.4 (c) 4 pF

1.13 $I = 18 \text{ A}$ along $-z$

1.14 (c) $i(t) = 0.12e^{-0.4t} \text{ (pA)}$

1.15 (d) $i(t) = 1.7(1 - e^{-1.2t} + 1.2te^{-1.2t}) \text{ nA}$

1.16 (b) $\Delta Q(1, 12) = 2.948 \text{ (C)}$

1.17 (b) $i = 0 @ t = 3 \text{ s.}$

1.20 $i = 4.8 \text{ A}$

1.22 (b) $i = 0$

1.23 (a) $i = 0$

1.25 (a) $V_2 = 48 \text{ V}$

1.26 (a) -4 V

1.29 $W = 432 \text{ kJ}$

1.31 (a) $p(0) = 0.5 \text{ W}; p(0.25 \text{ s}) = 0.5 \text{ W}$

1.36 $P_{\max} = 6 \text{ W}$

1.38 $V_y = 1.2 \text{ V}$

1.40 $V_z = 2.5 \text{ V}$

Chapter 2

2.2 $\ell \approx 2 \text{ km}$

2.3 (b) $R \approx 1,174 \Omega$

2.8 $R = 6.41 \Omega; i = 17.2 \text{ A}$

2.11 $R = 2500 \Omega$

2.15 $I_x = 2.43 \text{ A} \quad 0.5 \text{ W}$

2.17 $I_1 = 2 \text{ A}, I_2 = 1 \text{ A}, I_3 = 2 \text{ A}, I_4 = 1 \text{ A}$

2.19 $I_x = 3.57 \text{ A}; I_y = 2.86 \text{ A}$

2.23 $P = 0.32 \text{ W}$

2.25 $V_1 = -6 \text{ V}, V_2 = 0, V_3 = 6 \text{ V}$

2.29 $I_0 = 31 \text{ A}$

2.34 $R = 3 \text{ k}\Omega$

2.36 $V_x = 8 \text{ V}$

2.38 $R_{\text{eq}} = 9 \Omega$

2.41 (a) $R_{\text{eq}} = 5.5 \Omega$

2.44 $I = 2 \text{ A}$

2.49 $I = 1.97 \text{ A}$

2.51 $I = 3.8 \text{ mA}$

2.55 $P = 40 \text{ W}$

2.59 $P = 4 \text{ W}$

2.61 $R_{\text{eq}} = 10 \Omega$

2.63 (a) $R_3 = 1.5 \Omega$

2.66 $H = 0.6 \text{ mm}$

2.67 $I_1 = 0, I_2 = 0.1 \text{ A}$

Chapter 3

3.2 $I = 3 \text{ A}$

3.3 $P = -120 \text{ W}$

3.5 $V_R = 7 \text{ V}$

3.7 $I_x = -0.1 \text{ A}$

3.11 $P = -24 \text{ W}$

3.13 $I_x = 0.77 \text{ A}$

3.15 $I_x = 8 \text{ A}$

3.17 $V_x = 1.41 \text{ V}$

3.20 $I_x = 0.151 \text{ A}$

3.23 $V_x = -2.85 \text{ V}$

3.26 $V = 10 \text{ V}$

3.28 $V = 5 \text{ V}$

3.30 $I_x = -0.1 \text{ A}$

3.32 $V_x = 4 \text{ V}$

3.34 $V_x = -3 \text{ V}$

3.36 $I_x = 6.25 \text{ A}$

3.39 $I_x = 8 \text{ A}$ **3.42** $V_x = 1.67 \text{ V}$ **3.45** $I_0 = 0.6 \text{ A}$ **3.48** $I_x = 2 \text{ A}$ **3.52** $V_1 = 25.5 \text{ V}; V_2 = 4.5 \text{ V}$ **3.56** $V_x = 1.5 \text{ V}$ **3.58** $I = 0.05 \text{ A}$ **3.62** $V_x = -2.094 \text{ V}$ **3.64** $V_{\text{Th}} = 4 \text{ V}; R_{\text{Th}} = 5.2 \Omega$ **3.68** $V_{\text{Th}} = -7.6 \text{ V}; R_{\text{Th}} = 1.6 \Omega$ **3.72** $I_N = 7.71 \text{ A}, R_N = 4.54 \Omega$ **3.74** $I_N = 0.217 \text{ A}; R_{\text{Th}} = 9.2 \Omega$ **3.77** $V_{\text{Th}} = 1 \text{ V}, R_{\text{Th}} = 2.4 \Omega$ **3.80** $V_{\text{Th}} = 1 \text{ V}, R_{\text{Th}} = 0.5 \Omega$ **3.83** $P_{\text{max}} = 2.09 \text{ mW}$ **3.85** $P_{\text{max}} = 10 \text{ mW}$ **3.89** $I_0 \approx I_{\text{REF}}$ **3.93** $V_{\text{out}} \approx (R_L/R_E)V_{\text{in}}$

Chapter 4

4.2 $v_o = -10 \text{ V}$ **4.4** $v_o = -10 \text{ V}$ **4.6 (d)** $G = -100$ **4.9** $R_f = 16 \text{ k}\Omega$ **4.13** $G = R_L(R_1 + R_2)/[R_1(R_3 + R_L)]$ **4.14 (b)** $R_f = 180 \text{ k}\Omega$ **4.16** $R_L = 4 \text{ k}\Omega$ **4.19** $G = 0.33; -21 \text{ V} \leq v_s \leq 21 \text{ V}$ **4.21** $-2 \text{ V} \leq v_s \leq 2 \text{ V}$ **4.24** $v_o = 6.5 \text{ V}$ **4.30** $v_o = (38 - 4v_s) \text{ V}; 5.5 \text{ V} \leq v_s \leq 13.5 \text{ V}$ **4.35** $v_o = -3.23 \text{ V}$ **4.38** $v_o = 0.826 \text{ V}, P = 0.34 \text{ mW}$ **4.40 (a)** $G_1 = -6, G_2 = -20$ **4.46** $v_o = -[(R_3/R_2)(R_1 + R_2)/(R_1 + R_s)]v_s$ **4.50** $v_o = 8.5v_s$ **4.52** $v_o = -5.19 \text{ V}$ **4.54** $v_s = -0.1 \text{ V}$ **4.56** $G = 2 \times 10^5 \text{ to } 2 \times 10^6$ **4.60** $v_o = 2.5 - 10^4v_s$

Chapter 5

5.3 $v(t) = 10u(t - 2 \mu\text{s}) - 10u(t - 7 \mu\text{s}) \text{ V}$ **5.7** $v_o = 12 \text{ V}; \tau = 2 \text{ s.}$ **5.8** $v(t) = 2 + 8e^{-0.5t} \text{ V}$ **5.16** $v_1 = -12 \text{ V}; v_2 = 6 \text{ V}; v_3 = 2 \text{ V}$ **5.17** $C_{\text{eq}} = 4 \mu\text{F}$ **5.19** $C_{\text{eq}} = 2.95 \text{ F}$ **5.21** $8 \mu\text{F}: 60 \text{ V}; 3 \mu\text{F}: 60 \text{ V}; 6 \mu\text{F}: 20 \text{ V}; 6 \mu\text{F}: 30 \text{ V}; 12 \mu\text{F}: 10 \text{ V}; 10 \mu\text{F}: 30 \text{ V}$ **5.25** $i(t) = (0.25 - e^{-0.2t}) \text{ A}$ **5.29** $v_{C_1} = 20 \text{ V}; v_{C_2} = 12 \text{ V}; i_{L_1} = 0; i_{L_2} = 2 \text{ A}$ **5.31** $L_{\text{eq}} = 5 \text{ mH}$ **5.33 (c)** $i_C(\infty) = 0; v_C(\infty) = 8 \text{ V}$ **5.36** $v(t) = 14e^{-11.67t} \text{ V}$ **5.39** $v(t) = [-18 + 24e^{-1.25t}] \text{ V}$ **5.43** $v(t) = 5.35e^{-1000(t-0.1)/45} \text{ V}$ **5.45** $v_C(t) = 4e^{-100t/1.5} \text{ V}$ **5.48** $i(t) = 2e^{-100t/3} \text{ A}$ **5.50** $i_1(t) = 2.88e^{-10t} \text{ mA}; i_2(t) = 0.72e^{-20t} \text{ mA}$ **5.53** $i(t) = 0.3(1 - e^{-8t}) \text{ A}$ **5.56** $i(t) = [20 - 30e^{-500t}] \text{ mA}$ **5.60** $v_{\text{out}}(t) = v_{\text{out}}(0) + v_i(t) + \frac{1}{RC} \int_0^t v_i dt$ **5.63** $i_{\text{out}}(t) = 0.6e^{-2t} \text{ (mA)}$ **5.65 (b)** $v_{\text{out}}(t) = -24(1 - e^{-2t}) \text{ V}$ **5.68 (a)** $v_{\text{out}_1}(t) = -0.5t \text{ V}$ **5.73** $W = 0.2 \mu\text{m}$

Chapter 6

6.2 $v_C(0) = 12 \text{ V}, i_L(0) = 0, i_C(0) = -3 \text{ A}, v_L(0) = 12 \text{ V}, v_C(\infty) = 0, i_L(\infty) = 4 \text{ A}$ **6.3 (a)** $v_C(0) = -12 \text{ V}, i_L(0) = 3 \text{ mA}$ **6.8** $i_1(0) = 1 \text{ A}; i_2(0) = 2 \text{ A}$ **6.10** $i_C(0) = -3 \text{ A}, v_C(0) = -24 \text{ V}, i_R(0) = -3 \text{ A}, v_R(0) = -24 \text{ V}, i_L(0) = 0, v_L(0) = -24 \text{ V}, v_L(\infty) = 0, i_R(\infty) = 0, v_C(\infty) = 0, i_L(\infty) = 0$ **6.12** $v_C(t) = (12.64e^{-2.68t} - 3.64e^{-9.32t})$ **6.14** $i_L(t) = -90e^{-6t} \text{ A}$ **6.16** $v_C(t) = V_0 \cos(\omega_d t); \omega_d = 1/\sqrt{LC}$ **6.18** $i_C(t) = -[(40/3)e^{-0.5t} \sin 0.375t] \text{ A}$

- 6.22** $i_C(t) = (12 \sin t - 6 \cos t)e^{-2t}$ A
- 6.25** $v_C(t) = 0.4 + (2.44t - 0.2)e^{-5.81t}$ mV
- 6.28 (a)** $v_C(\infty) = 10$ V
- 6.29** $v_C(t) = (12 + 3e^{-60t})$ V
- 6.32** $v_C(t) = 4 - e^{-6000t} [10 \cos(11431t) - 5.25 \sin(11431t)]$ V
- 6.35** $v_C(t) = \frac{4}{3} + [\frac{20}{3} \cos(745.4t) + 5.96 \sin(745.4t)] e^{-666.7t}$ V
- 6.38** $i_L(t) = 1.5$ mA
- 6.40** $i_L(t) = [32 - (32 + 6400t)e^{-400t}]$ mA
- 6.43 (a)** $i_L(t) = -2 + [4.5 \cos(526.8t) + 7.26 \sin(526.8t)] e^{-850t}$ A,
(b) $v_C(\infty) = 0$
- 6.46 (a)** $i_L(t) = 2$ A
(b) No, the solution method is applicable to dc sources only.
- 6.47** $i_C(t) =$
 $\begin{cases} (-0.0045e^{-83t} + 0.1045e^{-1917t}) \text{ A} & \text{for } 0 \leq t \leq 1 \text{ ms} \\ (2.43 \times 10^{-3} \cos 400t - 0.017 \sin 400t) \text{ A} & \text{for } t \geq 1 \text{ ms} \end{cases}$
- 6.50** $v(t) = (24 - 14.4e^{-2t} + 6.4e^{-3t})$ V
- 6.52 (c)** $[3 \cos 0.433t + 5.2 \sin 0.433t] e^{-0.75t}$ A
- 6.54** $v_C(t) = 2.4 - (0.4 \cos 3.74t - 0.428 \sin 3.74t) e^{-6t}$ V
- 6.56** $i_2(t) = (2.3e^{0.89t} + 97.7e^{-5.61t})$ μ A
- 6.58** $v_{\text{out}}(t) = -8e^{-20t} \sin 74.83t$ V
- Chapter 7**
- 7.2** $A = 4$ V, $f = 4$ kHz, $t = 0.25$ ms, $\phi = 45^\circ$
- 7.3** $v(t) = 12 \cos(8\pi \times 10^3 t + 60^\circ)$ V
- 7.6** $\Delta t = 1/9$ μ s, waveform shifts backwards
- 7.9** $v(t) = 12 \cos(100\pi t - 45^\circ)$ V
- 7.10 (c)** $z_3 = 7.21e^{-j146.3^\circ}$
(e) $z_5 = 5e^{-j53.13^\circ}$
- 7.11 (c)** $z_3 = -1.22(1+j)$
(f) $z_6 = 3+j4$
- 7.14 (b)** $z^2 = 100e^{-j73.74^\circ}$
(f) $\Im(z^*) = -6$
- 7.15 (c)** $z_1 z_2^* = 10e^{-j105^\circ}$
- 7.16 (b)** $e^z = -2.45 - j2.24$
- 7.18 (b)** $\mathbf{B} = 42.5e^{-j161.99^\circ}$
- 7.20 (b)** $62.2e^{-j4.61^\circ}$
- 7.22 (b)** $\mathbf{V}_2 = 2e^{j108^\circ}$ V
- 7.23 (c)** $i_2(t) = 2 \cos(2\pi \times 10^3 t + 150^\circ)$ A
- 7.25 (c)** $Z_C = -j3.18$ Ω
- 7.27 (b)** $v_2(t) = 5.49 \cos(1000t - 18^\circ)$ V
- 7.29** $i_C(t) = 9.4 \cos(2\pi \times 10^4 t - 21.48^\circ)$ mA
- 7.32** $v_{ab}(t) = 0.42 \cos(300t - 96^\circ)$ V
- 7.34 (b)** $\mathbf{Z}_2 = (98.5 + j1524)$ Ω
- 7.36** $\mathbf{Z} = (5.32 - j1.69)$ Ω
- 7.38** $I_R = 2.528e^{j35.56^\circ}$ A
- 7.40 (a)** $\mathbf{Z} = (5 + j5)$ Ω
(b) $\mathbf{I} = 3.54$ A
- 7.44** $L = 0$ or 2.5 mH
- 7.48** $\mathbf{V}_{\text{Th}} = -12$ V; $\mathbf{Z}_{\text{Th}} = 0$
- 7.50** $\mathbf{Z}_L = (6 + j2)$ Ω
- 7.51** $\mathbf{Z}_L = (2 - j1)$ k Ω
- 7.56** $f = 795.8$ Hz
- 7.58** $i_C(t) = 1.25 \cos(400t - 6.35^\circ)$ A
- 7.60** $\mathbf{V}_1 = (20.7 + j16.1)$ V,
 $\mathbf{V}_2 = -(20.7 + j42.1)$ V
- 7.62** $I_C = 1.93e^{j4.9^\circ}$ A
- 7.65** $\mathbf{V}_{\text{out}} = \left(\frac{3+j1}{5}\right) \mathbf{V}_s$
- 7.68** $i_x(t) = 24.72 \cos(5 \times 10^5 t - 74.06^\circ)$ A
- 7.71** $\mathbf{V}_{\text{Th}} = 10e^{-j30.5^\circ}$ V, $\mathbf{Z}_{\text{Th}} = (5.32 + j1.89)$ Ω
- 7.74** $i_a(t) = 2.06 \cos(35t + 152.75^\circ)$ A
- 7.77** $I_a = 4.4e^{-j21.45^\circ}$ A
- 7.80** $v_{\text{out}}(t) = V_0 \sin \omega t$
- 7.83** $v_{\text{out}}(t) = 11.32 \cos(377t + 152.05^\circ)$ V
- Chapter 8**
- 8.2 (a)** $V_{\text{av}} = 2$ V
(b) $V_{\text{rms}} = 2.31$ V
- 8.4 (a)** $I_{\text{av}} = 3$ A
(b) $I_{\text{rms}} = 3.46$ A
- 8.7 (a)** $V_{\text{av}} = 2$ V
(b) $V_{\text{rms}} = 3.79$ V
- 8.10 (a)** $V_{\text{av}} = 2$ V
(b) $V_{\text{rms}} = 2.38$ V
- 8.12 (a)** $V_{\text{av}} = 0.432$ V
(b) $V_{\text{rms}} = 0.5136$ V
- 8.15 (c)** $V_{\text{av}} = 12$ V, $V_{\text{rms}} = 12.32$ V

- 8.17 (c)** $\mathbf{S} = 330e^{j15^\circ}$ VA, $P_{av} = 318.76$ W, $Q = 85.41$ VAR, $pf = 0.97$ (lagging)
- 8.18 (c)** $\mathbf{S} = 2.5e^{-j75^\circ}$ VA, $P_{av} = 0.65$ W, $Q = -2.415$ VAR, $pf = 0.26$ (leading)
- 8.21** $\mathbf{S} = 0.665e^{-j79.35^\circ}$ VA, $pf = 0.185$ (leading)
- 8.23** $P_{av}(200 \Omega) = 5.52$ W, $P_{av}(100 \Omega) = 1.38$ W, $P_{av}(\text{source}) = 6.9$ W
- 8.26** $P_{av} = 496.4$ mW
- 8.29** $P_L = 0.186$ W
- 8.31** $\mathbf{S}_{\text{load}} = (0.38 + j0.26)$ VA
- 8.34** $P_L = 3.933$ mW
- 8.36** $P_L = 0.713$ W
- 8.39** $P_{av} = 0.2$ mW
- 8.43** $\mathbf{Z}_{\text{eq}} = (29 + j8.93)$ Ω , inductive
 \mathbf{Z}_1 = inductive, \mathbf{Z}_2 = capacitive, \mathbf{Z}_3 = inductive
- 8.45** $C = L/(R^2 + \omega^2 L^2)$
- 8.48 (a)** $\mathbf{Z}_1 = (10.5 - j5.2)$ Ω ; $\mathbf{Z}_2 = (7.23 + j5.05)$ Ω
- 8.50 (a)** $pf = 0.673$ lagging
- 8.51** $\mathbf{Z}_L = (0.6 - j0.2)$ Ω , $P_{\max} = 6.78$ W
- 8.55** $\mathbf{Z}_L = (1.33 - j4)$ Ω , $P_{\max} = 4.18$ W
- 8.58** $\mathbf{Z}_L = (5.1568 + j0.72)$ Ω , $P_{\max} = 0.8$ W
- 8.60** $\mathbf{Z}_L = (22.9 + j39.8)$ Ω , $P_{\max} = 38.9$ mW
- Chapter 9**
- 9.2** $\omega_0 = 10^4$ rad/s
- 9.3** $\omega_0 = 10^5$ rad/s
- 9.5** $\omega_0 = 5 \times 10^4$ rad/s
- 9.8** $K_m = 50$; $K_f = 2 \times 10^4$
- 9.10 (b)** $\omega_0 = 1$ rad/s
- 9.13 (b)** -23 dB
- 9.14 (a)** 20.81 dB
- 9.16 (c)** 0.25
- 9.21** $\mathbf{H}(\omega) = \frac{-2000\omega}{(1+j\omega)(100+j\omega)}$
- 9.23** $\mathbf{H}(\omega) = -(10 + j\omega)(100 + j\omega)/50\omega$
- 9.26 (a)** $\omega_0 = 10^4$ rad/s, $Q = 40$, $B = 250$ rad/s,
 $\omega_{c_1} = 9875$ rad/s, $\omega_{c_2} = 10125$ rad/s
- 9.29** $\omega_0 = 5$ rad/s; $Q = 20$; $B = 25$ rad/s; $\omega_{c_1} = 487.5$ rad/s;
 $\omega_{c_2} = 512.5$ rad/s
- 9.32 (b)** $\mathbf{H}(\omega) = \frac{j10^{-3}\omega}{1 + j2.5\omega/1000 + (j\omega/1000)^2}$
- 9.35 (a)** $\mathbf{H}(\omega) = \frac{1}{2} \left(\frac{j\omega/\omega_c}{1 + j\omega/\omega_c} \right)$,
with $\omega_c = 1.25 \times 10^4$ rad/s
- 9.37 (a)** $\mathbf{H}(\omega) = \frac{1 + j\omega C(R_1 + R_2)}{1 + j\omega R_1 C}$
- 9.39 (a)** $\mathbf{H}(\omega) = \frac{1}{1 + j0.4\omega/5000 + (j\omega/5000)^2}$
- 9.41 (a)** $\mathbf{H}(\omega) = \left[\frac{-j(\omega/\omega_{c_1})}{(1 + j\omega/\omega_{c_2})(1 + j\omega/\omega_{c_3})} \right]$, with
 $\omega_{c_1} = 10^4$ rad/s, $\omega_{c_2} = 200$ rad/s, $\omega_{c_3} = 2 \times 10^6$ rad/s
- 9.46** $\mathbf{H}(\omega) = -10$
- 9.50** 77 to 92 MHz, or 97 to 112 MHz
- Chapter 10**
- 10.4** $V_1 = 100/-60^\circ$ V (rms), negative phase sequence
- 10.7** $v_{ab}(t) = 34.79 \cos(377t + 113.06^\circ)$ V
 $v_{bc}(t) = 81.58 \cos(377t + 47.78^\circ)$ V
 $v_{ca}(t) = 101.2 \cos(377t - 114.02^\circ)$ V
- 10.11** $i_{L_1}(t) = 22.73 \cos(2\pi ft + 16.9^\circ)$ A
 $i_{L_2}(t) = 27.71 \cos(2\pi ft - 100.5^\circ)$ A
 $i_{L_3}(t) = 26.56 \cos(2\pi ft + 129.0^\circ)$ A
- 10.14** $i_{L_1}(t) = 27.31 \cos(2\pi ft + 7.62^\circ)$ A
 $i_{L_2}(t) = 32.71 \cos(2\pi ft - 114.2^\circ)$ A
 $i_{L_3}(t) = 29.54 \cos(2\pi ft + 117.5^\circ)$ A
- 10.17** $I_{L_1} = 10.02/-59.3^\circ$ A (rms)
- 10.20** $I_n = 1.64/143.2^\circ$ A (rms)
- 10.23** $S_T = 29.68/-3.56^\circ$ kVA
- 10.26** $S_T = 29.68/-3.56^\circ$ kVA, 58.2%
- 10.28** $I_{L_1} = 25.61/-28.37^\circ$ A (rms)
 $I_{L_2} = 25.61/-148.37^\circ$ A (rms)
 $I_{L_3} = 25.61/91.69^\circ$ A (rms)
- 10.30** $I_{L_1} = 69.62/-19.1^\circ$ A (rms)
 $I_{L_2} = 69.62/-139.1^\circ$ A (rms)
 $I_{L_3} = 69.62/100.9^\circ$ A (rms)
 $pf = 0.9449$
- 10.33** $C = 2.261$ mF
- 10.34** $P_1 = 3.35$ kW, $P_2 = 6.194$ kW
- 10.36** $P_1 = P_2 = 50.82$ W
- Chapter 11**
- 11.2 (a)** $i(t) = 0.293 \cos(120\pi t - 125.8^\circ)$ A
(b) $P = 8.57$ W
- 11.4** $V_{\text{out}} = 2.629/164.4^\circ$ V

11.7 $I_x = 0.8622/-51.9^\circ$ A

11.9 $V_{\text{out}} = 0.8/-73.3^\circ$ V

11.11 $V_{\text{out}} = 24.83/-155.6^\circ$ V

11.13 (c) $L_{\text{eq}} = 2$ H

11.16 $Z_{\text{in}} = 18.28/-38.9^\circ$ Ω

11.17 $Z_{\text{in}} = 14.03/30.8^\circ$ Ω

11.19 $L_{\text{eq}} = 5.1$ H

11.21 $Z_{\text{in}} = (0.3 + j9.9)$ Ω

11.24 $V_{\text{out}} = 26.63/33.7^\circ$ V

11.25 $I_x = 24.25/-129^\circ$ mA

11.28 $P_L = 0.83$ W

11.31 $P_L = 2.676$ W

11.33 $n = 8/3$

Chapter 12

12.4 (c) $F_3(s) = \frac{12e^{-4s}}{s+3}$

12.5 (a) $H_1(s) = \left[\frac{48}{s+3} + \frac{12}{(s+3)^2} \right] e^{-4s}$

(c) $H_3(s) = \frac{60}{(s+2)^4}$

12.7 (c) $F_3(s) = \frac{10e^{-3s}}{s+4}$

12.9 (c) $f_3(t) = 2e^{-3t} \cos(2t + 45^\circ) u(t)$

12.10 (b) $f_2(t) = [2e^{-2t} - 4e^{-3t} \cos t] u(t)$

12.11 (b) $f_2(t) = 4(1 + \cos 3t) u(t)$

12.12 $i_L(t) = 8(e^{-t} - e^{-2t}) u(t)$ A

12.15 $i_L(t) = 1.14e^{-0.5(t-2)} \sin(0.87(t-2)) u(t-2)$ A

12.18 $v(t) = [1.5 - 1.56e^{-4t} + 0.072e^{-12t}] u(t)$ V

12.22 $i_L(t) = (0.012e^{-0.13t} - 0.81e^{-3.31t}) u(t)$ mA

12.25 $i_L(t) = 30e^{-2t} \sin t u(t)$

12.28 $i_L(t) = [2 + 7e^{-0.67t} \cos(1.43t - 1012.5^\circ)] u(t)$ A

12.31 $i_L(t) = [1.25 + 2.58e^{-1.75t} \cos(0.97t - 61^\circ)] u(t)$ A

12.34 $v_C(t) = 10(1 - e^{-t}) u(t) - 10[1 - e^{-(t-2)}] u(t-2)$ V

12.37 $i_L(t) = (21.52e^{-2t} - 112.14e^{-t} - 5.38e^{-5t}) u(t)$ A

12.44 (a) $v_{\text{out}}(t) = 2[1 - e^{-10^4 t}(1 + 10^4 t)] u(t)$ V

Chapter 13

13.5 (a) even and dc symmetry

(b) $f(t) = \sum_{n=1}^{\infty} \frac{160}{(n\pi)^2} \left[\cos\left(\frac{n\pi}{4}\right) - \cos\left(\frac{3n\pi}{4}\right) \right] \cdot \cos\left(\frac{n\pi t}{4}\right)$

13.5 (a) Odd and dc symmetry

(b) $f(t) = \sum_{n=1}^{\infty} \frac{10}{n\pi} [2 - \cos(n\pi)] \sin(n\pi t)$

13.12 $f(t) = \frac{1}{2} - \frac{1}{2} \cos(8\pi t)$

13.16 $f_2(t) = -\frac{40}{\pi} \sum_{n=1}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi t}{4}\right)$

13.26 (a) $v_{\text{out}}(t) = \sum_{n=1}^{\infty} 100 \times \left(\frac{4}{n\pi}\right)^2 \sin\left(\frac{n\pi}{2}\right) \cos(n\pi t + 90^\circ)$ V

13.29 $P_{\text{av}} = 54.5$ mW; ac power fraction = 8.26%

13.33 $F(\omega) = \frac{5}{3\omega^2} [(1 + j3\omega)e^{-j3\omega} - 1]$

13.39 $F(\omega) = \frac{3}{\omega} \left[-2j - \frac{2j}{\omega} (\sin \omega - \sin 2\omega) \right]$

13.46 (b) $t f(t) \leftrightarrow \frac{5}{(2+j\omega)^2}$



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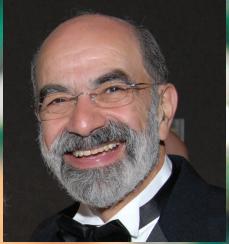
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CIRCUIT ANALYSIS AND DESIGN

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