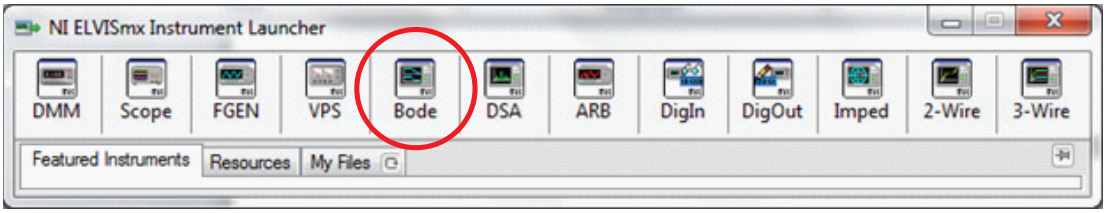
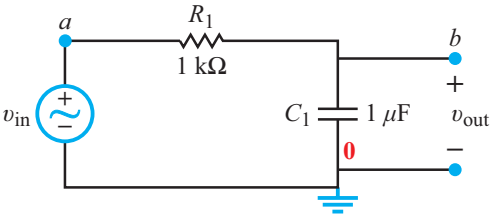
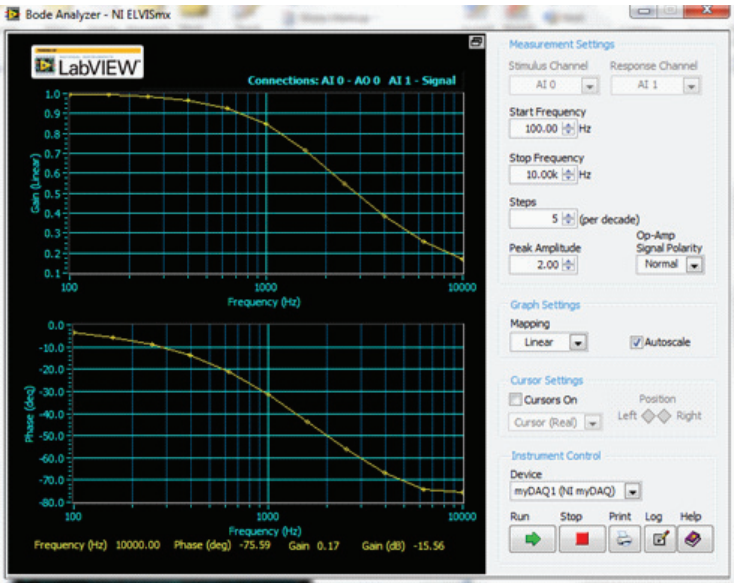


Figure F-30: Bode analyzer.



(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 μA
(d) 390 GV

1.4 **(c)** 4 pF

1.13 $I = 18$ A along $-z$

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

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

1.16 **(b)** $\Delta Q(1, 12) = 2.948$ (C)

1.17 **(b)** $i = 0$ @ $t = 3$ s.

1.20 $i = 4.8$ A

1.22 **(b)** $i = 0$

1.23 **(a)** $i = 0$

1.25 **(a)** $V_2 = 48$ V

1.26 **(a)** -4 V

1.29 $W = 432$ kJ

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

1.36 $P_{\max} = 6$ W

1.38 $V_y = 1.2$ V

1.40 $V_z = 2.5$ V

Chapter 2

2.2 $\ell \approx 2$ km

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

2.8 $R = 6.41\ \Omega$; $i = 17.2$ A

2.11 $R = 2500\ \Omega$

2.15 $I_x = 2.43$ A 0.5 W

2.17 $I_1 = 2$ A, $I_2 = 1$ A, $I_3 = 2$ A, $I_4 = 1$ A

2.19 $I_x = 3.57$ A; $I_y = 2.86$ A

2.23 $P = 0.32$ W

2.25 $V_1 = -6$ V, $V_2 = 0$, $V_3 = 6$ V

2.29 $I_0 = 31$ A

2.34 $R = 3$ kΩ

2.36 $V_x = 8$ V

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

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

2.44 $I = 2$ A

2.49 $I = 1.97$ A

2.51 $I = 3.8$ mA

2.55 $P = 40$ W

2.59 $P = 4$ W

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

2.63 **(a)** $R_3 = 1.5\ \Omega$

2.66 $H = 0.6$ mm

2.67 $I_1 = 0$, $I_2 = 0.1$ A

Chapter 3

3.2 $I = 3$ A

3.3 $P = -120$ W

3.5 $V_{\text{R}} = 7$ V

3.7 $I_x = -0.1$ A

3.11 $P = -24$ W

3.13 $I_x = 0.77$ A

3.15 $I_x = 8$ A

3.17 $V_x = 1.41$ V

3.20 $I_x = 0.151$ A

3.23 $V_x = -2.85$ V

3.26 $V = 10$ V

3.28 $V = 5$ V

3.30 $I_x = -0.1$ A

3.32 $V_x = 4$ V

3.34 $V_x = -3$ V

3.36 $I_x = 6.25$ A

3.39 $I_x = 8$ A

3.42 $V_x = 1.67$ V

3.45 $I_0 = 0.6$ A

3.48 $I_x = 2$ A

3.52 $V_1 = 25.5$ V; $V_2 = 4.5$ V

3.56 $V_x = 1.5$ V

3.58 $I = 0.05$ A

3.62 $V_x = -2.094$ V

3.64 $V_{\text{Th}} = 4$ V; $R_{\text{Th}} = 5.2\ \Omega$

3.68 $V_{\text{Th}} = -7.6$ V; $R_{\text{Th}} = 1.6\ \Omega$

3.72 $I_{\text{N}} = 7.71$ A, $R_{\text{N}} = 4.54\ \Omega$

3.74 $I_{\text{N}} = 0.217$ A; $R_{\text{Th}} = 9.2\ \Omega$

3.77 $V_{\text{Th}} = 1$ V, $R_{\text{Th}} = 2.4\ \Omega$

3.80 $V_{\text{Th}} = 1$ V, $R_{\text{Th}} = 0.5\ \Omega$

3.83 $P_{\text{max}} = 2.09$ mW

3.85 $P_{\text{max}} = 10$ mW

3.89 $I_0 \approx I_{\text{REF}}$

3.93 $V_{\text{out}} \approx (R_{\text{L}}/R_{\text{E}})V_{\text{in}}$

Chapter 4

4.2 $v_{\text{o}} = -10$ V

4.4 $v_{\text{o}} = -10$ V

4.6 **(d)** $G = -100$

4.9 $R_{\text{f}} = 16\ \text{k}\Omega$

4.13 $G = R_{\text{L}}(R_1 + R_2)/[R_1(R_3 + R_{\text{L}})]$

4.14 **(b)** $R_{\text{f}} = 180\ \text{k}\Omega$

4.16 $R_{\text{L}} = 4\ \text{k}\Omega$

4.19 $G = 0.33$; $-21\ \text{V} \le v_{\text{s}} \le 21$ V

4.21 $-2\ \text{V} \le v_{\text{s}} \le 2$ V

4.24 $v_{\text{o}} = 6.5$ V

4.30 $v_{\text{o}} = (38 - 4v_{\text{s}})$ V; $5.5\ \text{V} \le v_{\text{s}} \le 13.5$ V

4.35 $v_{\text{o}} = -3.23$ V

4.38 $v_{\text{o}} = 0.826$ V, $P = 0.34$ mW

4.40 **(a)** $G_1 = -6$, $G_2 = -20$

4.46 $v_{\text{o}} = -[(R_3/R_2)(R_1 + R_2)/(R_1 + R_{\text{s}})]v_{\text{s}}$

4.50 $v_{\text{o}} = 8.5v_{\text{s}}$

4.52 $v_{\text{o}} = -5.19$ V

4.54 $v_{\text{s}} = -0.1$ V

4.56 $G = 2 \times 10^5$ to 2×10^6

4.60 $v_{\text{o}} = 2.5 - 10^4 v_{\text{s}}$

Chapter 5

5.3 $v(t) = 10u(t - 2\ \mu\text{s}) - 10u(t - 7\ \mu\text{s})$ V

5.7 $v_{\text{o}} = 12$ V; $\tau = 2$ s.

5.8 $v(t) = 2 + 8e^{-0.5t}$ V

5.16 $v_1 = -12$ V; $v_2 = 6$ V; $v_3 = 2$ V

5.17 $C_{\text{eq}} = 4\ \mu\text{F}$

5.19 $C_{\text{eq}} = 2.95$ F

5.21 8 μF: 60 V; 3 μF: 60 V; 6 μF: 20 V; 6 μF: 30 V; 12 μF: 10 V; 10 μF: 30 V

5.25 $i(t) = (0.25 - e^{-0.2t})$ A

5.29 $v_{C_1} = 20$ V; $v_{C_2} = 12$ V; $i_{L_1} = 0$; $i_{L_2} = 2$ A

5.31 $L_{\text{eq}} = 5$ mH

5.33 **(c)** $i_{\text{C}}(\infty) = 0$; $v_{\text{C}}(\infty) = 8$ V

5.36 $v(t) = 14e^{-11.67t}$ V

5.39 $v(t) = [-18 + 24e^{-1.25t}]$ V

5.43 $v(t) = 5.35e^{-1000(t-0.1)/45}$ V

5.45 $v_{\text{C}}(t) = 4e^{-100t/1.5}$ V

5.48 $i(t) = 2e^{-100t/3}$ A

5.50 $i_1(t) = 2.88e^{-10t}$ mA; $i_2(t) = 0.72e^{-20t}$ mA

5.53 $i(t) = 0.3(1 - e^{-8t})$ A

5.56 $i(t) = [20 - 30e^{-500t}]$ mA

5.60 $v_{\text{out}}(t) = v_{\text{out}}(0) + v_{\text{i}}(t) + \dfrac{1}{RC}\displaystyle\int_0^t v_{\text{i}}\, dt$

5.63 $i_{\text{out}}(t) = 0.6e^{-2t}$ (mA)

5.65 **(b)** $v_{\text{out}}(t) = -24(1 - e^{-2t})$ V

5.68 **(a)** $v_{\text{out}_1}(t) = -0.5t$ V

5.73 $W = 0.2\ \mu\text{m}$

Chapter 6

6.2 $v_{\text{C}}(0) = 12$ V, $i_{\text{L}}(0) = 0$, $i_{\text{C}}(0) = -3$ A, $v_{\text{L}}(0) = 12$ V, $v_{\text{C}}(\infty) = 0$, $i_{\text{L}}(\infty) = 4$ A

6.3 **(a)** $v_{\text{C}}(0) = -12$ V, $i_{\text{L}}(0) = 3$ mA

6.8 $i_1(0) = 1$ A; $i_2(0) = 2$ A

6.10 $i_{\text{C}}(0) = -3$ A, $v_{\text{C}}(0) = -24$ V, $i_{\text{R}}(0) = -3$ A, $v_{\text{R}}(0) = -24$ V, $i_{\text{L}}(0) = 0$, $v_{\text{L}}(0) = -24$ V, $v_{\text{L}}(\infty) = 0$, $i_{\text{R}}(\infty) = 0$, $v_{\text{C}}(\infty) = 0$, $i_{\text{L}}(\infty) = 0$

6.12 $v_{\text{C}}(t) = (12.64e^{-2.68t} - 3.64e^{-9.32t})$

6.14 $i_{\text{L}}(t) = -90e^{-6t}$ A

6.16 $v_{\text{C}}(t) = V_0 \cos(\omega_{\text{d}} t)$; $\omega_{\text{d}} = 1/\sqrt{LC}$

6.18 $i_{\text{C}}(t) = -[(40/3)e^{-0.5t} \sin 0.375t]$ 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 $v_C(t) = \frac{4}{3} + \left[\frac{20}{3}\cos(745.4t) + 5.96\sin(745.4t)\right]e^{-666.7t}$ 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) $w_C(\infty) = 0$

6.46 **(a)** $i_L(t) = 2$ A

(b) No, the solution method is applicable to dc sources only.

6.47 $i_C(t) =$
$$\begin{cases} (-0.0045e^{-83t} + 0.1045e^{-1917t})\text{ A} & \text{for } 0 \le t \le 1\text{ ms} \\ (2.43\times10^{-3}\cos 400t - 0.017\sin 400t)\text{ A} & \text{for } t \ge 1\text{ ms} \end{cases}$$

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 $v_C(t) = 2.4 - (0.4\cos 3.74t - 0.428\cos 3.74t)e^{-6t}$ V

6.56 $i_2(t) = (2.3e^{0.89t} + 97.7e^{-5.61t})\ \mu$A

6.58 $v_{out}(t) = -8e^{-20t}\sin 74.83t$ V

Chapter 7

7.2 $A = 4$ V, $f = 4$ kHz, $t = 0.25$ ms, $\phi = 45°$

7.3 $v(t) = 12\cos(8\pi\times10^3 t + 60°)$ V

7.6 $\Delta t = 1/9\ \mu$s, waveform shifts backwards

7.9 $v(t) = 12\cos(100\pi t - 45°)$ V

7.10 **(c)** $\mathbf{z}_3 = 7.21e^{-j146.3°}$

(e) $\mathbf{z}_5 = 5e^{-j53.13°}$

7.11 **(c)** $\mathbf{z}_3 = -1.22(1 + j)$

(f) $\mathbf{z}_6 = 3 + j4$

7.14 **(b)** $\mathbf{z}^2 = 100e^{-j73.74°}$

(f) $\Im\mathrm{m}(\mathbf{z}^*) = -6$

7.15 **(c)** $\mathbf{z}_1\mathbf{z}_2^* = 10e^{-j105°}$

7.16 **(b)** $e^{\mathbf{z}} = -2.45 - j2.24$

7.18 **(b)** $\mathbf{B} = 42.5e^{-j161.99°}$

7.20 **(b)** $62.2e^{-j4.61°}$

7.22 **(b)** $\mathbf{V}_2 = 2e^{j108°}$ V

7.23 **(c)** $i_2(t) = 2\cos(2\pi\times10^3 t + 150°)$ A

7.25 **(c)** $\mathbf{Z}_C = -j3.18\ \Omega$

7.27 **(b)** $v_2(t) = 5.49\cos(1000t - 18°)$ V

7.29 $i_C(t) = 9.4\cos(2\pi\times10^4 t - 21.48°)$ mA

7.32 $v_{ab}(t) = 0.42\cos(300t - 96°)$ V

7.34 **(b)** $\mathbf{Z}_2 = (98.5 + j1524)\ \Omega$

7.36 $\mathbf{Z} = (5.32 - j1.69)\ \Omega$

7.38 $\mathbf{I}_R = 2.528e^{j35.56°}$ A

7.40 **(a)** $\mathbf{Z} = (5 + j5)\ \Omega$

(b) $\mathbf{I} = 3.54$ A

7.44 $L = 0$ or 2.5 mH

7.48 $\mathbf{V}_{Th} = -12$ V; $\mathbf{Z}_{Th} = 0$

7.50 $\mathbf{Z}_L = (6 + j2)\ \Omega$

7.51 $\mathbf{Z}_L = (2 - j1)$ kΩ

7.56 $f = 795.8$ Hz

7.58 $i_C(t) = 1.25\cos(400t - 6.35°)$ A

7.60 $\mathbf{V}_1 = (20.7 + j16.1)$ V,
$\mathbf{V}_2 = -(20.7 + j42.1)$ V

7.62 $\mathbf{I}_C = 1.93e^{j4.9°}$ A

7.65 $\mathbf{V}_{out} = \left(\frac{3 + j1}{5}\right)\mathbf{V}_s$

7.68 $i_x(t) = 24.72\cos(5\times10^5 t - 74.06°)$ A

7.71 $\mathbf{V}_{Th} = 10e^{-j30.5°}$ V, $\mathbf{Z}_{Th} = (5.32 + j1.89)\ \Omega$

7.74 $i_a(t) = 2.06\cos(35t + 152.75°)$ A

7.77 $\mathbf{I}_a = 4.4e^{-j21.45°}$ A

7.80 $v_{out}(t) = V_0\sin\omega t$

7.83 $v_{out}(t) = 11.32\cos(377t + 152.05°)$ V

Chapter 8

8.2 **(a)** $V_{av} = 2$ V

(b) $V_{rms} = 2.31$ V

8.4 **(a)** $I_{av} = 3$ A

(b) $I_{rms} = 3.46$ A

8.7 **(a)** $V_{av} = 2$ V

(b) $V_{rms} = 3.79$ V

8.10 **(a)** $V_{av} = 2$ V

(b) $V_{rms} = 2.38$ V

8.12 **(a)** $V_{av} = 0.432$ V

(b) $V_{rms} = 0.5136$ V

8.15 **(c)** $V_{av} = 12$ V, $V_{rms} = 12.32$ 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 $\mathbf{S}_{load} = (0.38 + j0.26)$ VA

8.34 $P_L = 3.933$ mW

8.36 $P_L = 0.713$ W

8.39 $P_{av} = 0.2$ mW

8.43 $\mathbf{Z}_{eq} = (29 + j8.93)\ \Omega$, 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) $\mathbf{Z}_1 = (10.5 - j5.2)\ \Omega$; $\mathbf{Z}_2 = (7.23 + j5.05)\ \Omega$

8.50 (a) $pf = 0.673$ lagging

8.51 $\mathbf{Z}_L = (0.6 - j0.2)\ \Omega$, $P_{max} = 6.78$ W

8.55 $\mathbf{Z}_L = (1.33 - j4)\ \Omega$, $P_{max} = 4.18$ W

8.58 $\mathbf{Z}_L = (5.1568 + j0.72)\ \Omega$, $P_{max} = 0.8$ W

8.60 $\mathbf{Z}_L = (22.9 + j39.8)\ \Omega$, $P_{max} = 38.9$ 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 $\mathbf{H}(\omega) = \dfrac{-2000\omega}{(1 + j\omega)(100 + j\omega)}$

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) $\mathbf{H}(\omega) = \dfrac{j10^{-3}\omega}{1 + j2.5\omega/1000 + (j\omega/1000)^2}$

9.35 (a) $\mathbf{H}(\omega) = \dfrac{1}{2}\left(\dfrac{j\omega/\omega_c}{1 + j\omega/\omega_c}\right)$, with $\omega_c = 1.25 \times 10^4$ rad/s

9.37 (a) $\mathbf{H}(\omega) = \dfrac{1 + j\omega C(R_1 + R_2)}{1 + j\omega R_1 C}$

9.39 (a) $\mathbf{H}(\omega) = \dfrac{1}{1 + j0.4\omega/5000 + (j\omega/5000)^2}$

9.41 (a) $\mathbf{H}(\omega) = \left[\dfrac{-j(\omega/\omega_{c_1})}{(1 + j\omega/\omega_{c_2})(1 + j\omega/\omega_{c_3})}\right]$, 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 $\mathbf{V}_1 = 100\underline{/-60^\circ}$ 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 $\mathbf{I}_{L_1} = 10.02\underline{/-59.3^\circ}$ A (rms)

10.20 $\mathbf{I}_n = 1.64\underline{/143.2^\circ}$ A (rms)

10.23 $\mathbf{S}_T = 29.68\underline{/-3.56^\circ}$ kVA

10.26 $\mathbf{S}_T = 29.68\underline{/-3.56^\circ}$ kVA, 58.2%

10.28 $\mathbf{I}_{L_1} = 25.61\underline{/-28.37^\circ}$ A (rms)
$\mathbf{I}_{L_2} = 25.61\underline{/-148.37^\circ}$ A (rms)
$\mathbf{I}_{L_3} = 25.61\underline{/91.69^\circ}$ A (rms)

10.30 $\mathbf{I}_{L_1} = 69.62\underline{/-19.1^\circ}$ A (rms)
$\mathbf{I}_{L_2} = 69.62\underline{/-139.1^\circ}$ A (rms)
$\mathbf{I}_{L_3} = 69.62\underline{/100.9^\circ}$ 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 $\mathbf{V}_{out} = 2.629\underline{/164.4^\circ}$ V

11.7 $\mathbf{I}_x = 0.8622\angle -51.9°$ A

11.9 $\mathbf{V}_{out} = 0.8\angle -73.3°$ V

11.11 $\mathbf{V}_{out} = 24.83\angle -155.6°$ V

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

11.16 $\mathbf{Z}_{in} = 18.28\angle -38.9°\ \Omega$

11.17 $\mathbf{Z}_{in} = 14.03\angle 30.8°\ \Omega$

11.19 $L_{eq} = 5.1$ H

11.21 $\mathbf{Z}_{in} = (0.3 + j9.9)\ \Omega$

11.24 $\mathbf{V}_{out} = 26.63\angle 33.7°$ V

11.25 $\mathbf{I}_x = 24.25\angle -129°$ 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)** $\mathbf{F}_3(\mathbf{s}) = \dfrac{12e^{-4\mathbf{s}}}{\mathbf{s}+3}$

12.5 **(a)** $\mathbf{H}_1(\mathbf{s}) = \left[\dfrac{48}{\mathbf{s}+3} + \dfrac{12}{(\mathbf{s}+3)^2}\right] e^{-4\mathbf{s}}$

(c) $\mathbf{H}_3(\mathbf{s}) = \dfrac{60}{(\mathbf{s}+2)^4}$

12.7 **(c)** $\mathbf{F}_3(\mathbf{s}) = \dfrac{10e^{-3\mathbf{s}}}{\mathbf{s}+4}$

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

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

12.31 $i_L(t) = [1.25 + 2.58e^{-1.75t}\cos(0.97t - 61°)]\, u(t)$ 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)** $v_{out}(t) = 2[1 - e^{-10^4 t}(1 + 10^4 t)]\, u(t)$ V

Chapter 13

13.5 **(a)** even and dc symmetry

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

13.5 **(a)** Odd and dc symmetry

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

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

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

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

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

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

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

13.46 **(b)** $t\, f(t) \quad \longleftrightarrow \quad \dfrac{5}{(2 + j\omega)^2}$

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CIRCUIT ANALYSIS AND DESIGN

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