Chapter 14 Answers to Assigned Homework

4. (a) $s = \pm j100 \text{ s}^{-1}$ (b) $s = 0 \text{ s}^{-1}$

   (c) $s = -7 \pm j80 \text{ s}^{-1}$ (d) $s = 8 \text{ s}^{-1}$

   (e) $s = -2 \pm j4 \text{ , } -1 \pm j4 \text{ s}^{-1}$

5. (a) $s = -9 + j100 \text{ s}^{-1} \text{ , } s^* = -9 - j100 \text{ s}^{-1}$

   (b) $s = j9 \text{ s}^{-1} \text{ , } s^* = -j9 \text{ s}^{-1}$ (c) $s = j45 \text{ s}^{-1} \text{ , } s^* = -j45 \text{ s}^{-1}$

   (d) $s = 7 + j7 \text{ s}^{-1} \text{ , } s^* = 7 - j7 \text{ s}^{-1}$

7. (a) $\text{i}(0) = 2.525 \text{ mA} \text{ , } \text{i}(0.1) = 2.863 \text{ mA} \text{ , } \text{i}(0.5) = 4.733 \text{ mA}$

   (b) $\text{i}(0) = 0.7212 \text{ mA} \text{ , } \text{i}(0.1) = 0.453 \text{ mA} \text{ , } \text{i}(0.5) = 0.428 \text{ mA}$

9. (a) $9\cos(4t) \text{ V}$ (b) 12 V (c) $5\cos(100t) \text{ V}$

   (d) $2\cos(3t) - \sin(3t) \text{ V}$

10. (a) $+V_x^* e^{(-2-j60)t}$. I know it is missing because the real voltage has to be ultimately a real-valued function.

    (b) $s = -2 \pm j60 \text{ s}^{-1}$

    (c) The imaginary part being larger means that the voltage is closer to being a sine than a cosine.

    (d) The real part being smaller means that the voltage is a slowly damped sinusoid with many cycles occurring before the voltage decays to zero.

12. (a) $s^* = -1 - j100 \text{ s}^{-1}$

    (b) $\text{v}(t) = 2.5e^{-t}\cos(100t - 20°) \text{ V}$

    (c) $\text{i}(t) = 13.89e^{-t}\cos(100t - 110°) \text{ mA}$

14. $\dfrac{V_2}{V_1} = 1.19\angle 143.13°$

15. $\mathrm{v}_2(t) = 5e^{-150t}\cos(100t - 25°)$

17. $\mathrm{i}_s(t) = 0.675e^{-2t}\cos(1.5t + 165°)$

18. (a) $\pm j5\,\mathrm{s}^{-1}$ (b) $V_S(s) = 10\angle 0°$ V.

(c) $\mathrm{I}_x(s) = 1.3343\angle -71.32°$ A

(d) $\mathrm{i}_x(t) = 1.3343\cos(5t - 71.32°)\,\mathrm{A}$

19. $\mathrm{v}_s(t) = 4.43e^{-t}\cos(0.5t + 16.48°)$ V

21. (a) $\mathscr{L}(2.1\mathrm{u}(t)) = \dfrac{2.1}{s}$, $\mathrm{Re}(s) > 0$

(b) $\mathscr{L}(2\mathrm{u}(t-1)) = \dfrac{2e^{-s}}{s}$, $\mathrm{Re}(s) > 0$

(c) $\mathscr{L}(5\mathrm{u}(t-2) - 2\mathrm{u}(t)) = \dfrac{5e^{-2s} - 2}{s}$, $\mathrm{Re}(s) > 0$

(d) $\mathscr{L}(3\mathrm{u}(t-b)) = \dfrac{3e^{-bs}}{s}$, $\mathrm{Re}(s) > 0$

22. (a) $\dfrac{5e^{-6s}}{s}$, $\mathrm{Re}(s) = \sigma > 0$

(b) $\dfrac{2}{s+1}$, $\mathrm{Re}(s) = \sigma > -1$

(c) $\dfrac{0.738e^{-s}}{s+1}$, $\mathrm{Re}(s) = \sigma > -1$

(d) $\dfrac{5}{(s+2)^2 + 25}$, $\mathrm{Re}(s) = \sigma > -2$

23. (a) $\dfrac{e^{-s}}{s^2}$, $\mathrm{Re}(s) > 0$ (b) $\dfrac{2}{s^2}$, $\mathrm{Re}(s) > 0$

24. Proofs

25. (a) $t+4$, $\sigma_0 > 0$

(b) $(t+1)(t-2)$, $\sigma_0 > 0$

(c) $\dfrac{2}{s+1/2}$, $\mathrm{Re}(s) > -0.5 \Rightarrow \sigma_0 = -0.5$

(d) $\dfrac{10}{s^2+100}$, $\mathrm{Re}(s) > 0 \Rightarrow \sigma_0 > 0$

28. (a) $\dfrac{24}{s}$, $\mathrm{Re}(s) = \sigma > 0$

(b) $2\dfrac{1-e^{-2s}}{s}$, $\mathrm{Re}(s) = \sigma > 0$

(c) $\dfrac{1}{s^2}$, $\mathrm{Re}(s) = \sigma > 0$

(d) $\dfrac{5s+3}{s(s+1)}$, $\mathrm{Re}(s) = \sigma > -1$

30. (a) $1.5te^{-9t}\,\mathrm{u}(t)$ (b) $2\,\mathrm{u}(t)$ (c) $\pi\delta(t)$

(d) $ate^{-t}\,\mathrm{u}(t) - a\delta(t)$

31. (a) $\delta(1) = 0$ (b) $5\delta(0+1) + \mathrm{u}(0+1) = 1$

(c) $\displaystyle\int_{-1}^{2} \delta(t)\,dt = 1$ (d) $\displaystyle 3 - \int_{-1}^{2} 2\delta(t)\,dt = 1$

34. (a) e^{-100} (b) 8 (c) 9 (d) $\dfrac{3}{5}$

35. (a) $5\left[\delta(t) + \left(1-e^{-t}\right)t\,\mathrm{u}(t)\right]$ (b) $\mathrm{u}(t) + 50e^{-40t}\,\mathrm{u}(t) - 3\delta(t)$

(c) $-0.5\,\mathrm{u}(t) + 4t\,\mathrm{u}(t) + 4te^{-5t}\,\mathrm{u}(t) + 2\delta(t)$

(d) $\left[4te^{-5t}+2e^{-t}+e^{-3t}\right]\mathrm{u}(t)$

37. (a) $e^{-2t}\,\mathrm{u}(t)$ (b) $\delta(t)$ (c) $3e^{-t}\left[\cos\left(\sqrt{3}t\right)+\dfrac{\sin\left(\sqrt{3}t\right)}{\sqrt{3}}\right]\mathrm{u}(t)$

(d) $2\delta(t)-3e^{-3t/2}\,\mathrm{u}(t)$

38. (a) $\dfrac{d}{dt}\delta(t)+2\,\mathrm{u}(t)+\delta(t)$ (b) $\delta(t)+8\,\mathrm{u}(t)+2t\,\mathrm{u}(t)$

(c) $\dfrac{1}{2}\left(1-e^{-2t}\right)\mathrm{u}(t)+2\delta(t)-t\,\mathrm{u}(t)$ (d) $\dfrac{d}{dt}\delta(t)+4\delta(t)+4\,\mathrm{u}(t)$

42. (a) $\left[(25/48)-(1/2)e^{-t/2}-(3/16)e^{-4t}-(3/4)te^{-4t}\right]\mathrm{u}(t)-\delta(t)$

(b) $\left[(1/3)e^{-5t/3}+12t-6+6e^{-2t}\right]\mathrm{u}(t)$ (c) $2(1-at)e^{-at}\,\mathrm{u}(t)$

46. $0.7\,\mathrm{u}(t)=\dfrac{\mathrm{v}(t)}{2}+0.5\,\mathrm{v}'(t)\Rightarrow 0.7/s=\mathrm{V}(s)/2+(s/2)\mathrm{V}(s)-0.75$

$$\mathrm{V}(s)=1.5\left(\frac{0.9333}{s}+\frac{0.0667}{s+1}\right)\Rightarrow \mathrm{v}(t)=1.5\left(0.9333+0.0667e^{-t}\right)\mathrm{u}(t)$$

50. (a)

$$-\mathrm{v}_s(t)+\frac{1}{C}\int_0^t \mathrm{i}(\lambda)\,d\lambda+\mathrm{v}_c(0)+5\,\mathrm{i}(t)=0\Rightarrow\frac{2}{s+1}=(5/s)I(s)+4.5/s+5I(s)$$

$$\mathrm{i}(t)=-(1/2)e^{-t}\left[1+(4/5)t\right]\mathrm{u}(t)$$

52. $$\mathrm{F}(s)=6\frac{e^{-1.6s}+e^{-3s}-2e^{-4.6s}}{s}$$

61. (a) 8 ohm resistor. (b) 2 henry inductor.

63. $$\mathrm{i}_C(t)=1.67e^{-3.333t}\,\mathrm{u}(t)+(1/3)\left[5e^{-3.333t}-6e^{-4t}\right]$$