

**Sample Instructor Solutions** (these solutions are deliberately incomplete—a complete set of solutions will be provided for instructors who adopt the book for classroom use)



# ENGINEERING SIGNALS AND SYSTEMS

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**Problem 1.1** Is each of these 1-D signals:

- Analog or digital?
  - Continuous-time or discrete-time?
- (a) Daily closes of the stock market  
(b) Output from phonograph record pickup  
(c) Output from compact disc pickup

**Solution:**

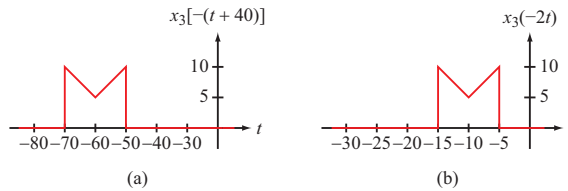
- (a) Stock market closes are recorded only at the end of each day, but indices take on a continuous range of values. Analog and discrete time.

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**Problem 1.6** Given the waveform of  $x_3(t)$  shown in Fig. P1.4(c), generate and plot the waveform of:

- (a)  $x_3[-(t + 40)]$
- (b)  $x_3(-2t)$

**Solution:**



- (a)  $x_3[-(t + 40)]$  is  $x_3(t)$  reversed in time, then advanced by 40.

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**Problem 1.16** For each of the following functions, indicate if it exhibits even symmetry, odd symmetry, or neither one:

(a)  $x_1(t) = 3t^2 + 4t^4$

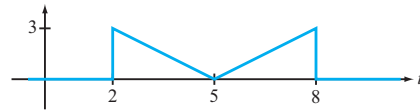
(b)  $x_2(t) = 3t^3$

**Solution:** A function has even symmetry if  $x(-t) = x(t)$ , and odd symmetry if  $x(-t) = -x(t)$ .

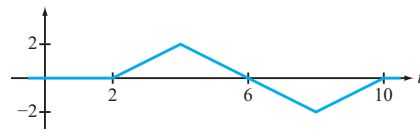
(a)  $x_1(-t) = 3(-t)^2 + 4(-t)^4 = 3t^2 + 4t^4 = x_1(t)$ . Even.

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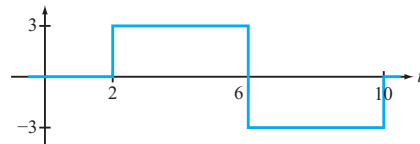
**Problem 1.27** Provide expressions for the waveforms displayed in Fig. 1.27 in terms of ramp and step functions.



(a)  $x_1(t)$  "M"



(b)  $x_2(t)$  "triangle"



(c)  $x_3(t)$  "Haar"

**Figure P1.27:** Waveforms for Problem 1.27.

**Solution:** A delayed step drops the waveform. A delayed ramp reduces its slope by one.

(a) 
$$x_1(t) = 3u(t-2) - r(t-2) + 2r(t-5) - r(t-8) - 3u(t-8).$$