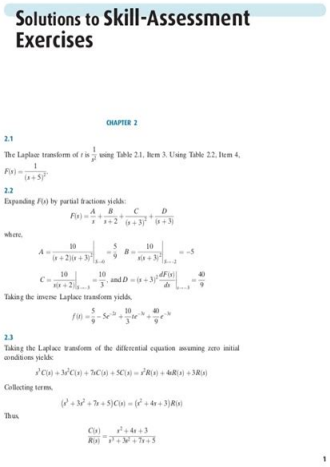

Solutions to Skill-Assessment Exercises

CHAPTER 2

2.1

The Laplace transform of t is $\frac{1}{s^2}$ using Table 2.1, Item 3. Using Table 2.2, Item 4, $F(s) = \frac{1}{(s+5)^2}$.

2.2

Expanding $F(s)$ by partial fractions yields:

$$F(s) = \frac{A}{s} + \frac{B}{s+2} + \frac{C}{(s+3)^2} + \frac{D}{(s+3)}$$

where,

$$A = \frac{10}{(s+2)(s+3)^2}\bigg|_{s=0} = \frac{5}{9} \quad B = \frac{10}{s(s+3)^2}\bigg|_{s=-2} = -5$$

$$C = \frac{10}{s(s+2)}\bigg|_{s=-3} = \frac{10}{3}, \text{ and } D = (s+3)^2\frac{dF(s)}{ds}\bigg|_{s=-3} = \frac{40}{9}$$

Taking the inverse Laplace transform yields,

$$f(t) = \frac{5}{9} - 5e^{-2t} + \frac{10}{3}te^{-3t} + \frac{40}{9}e^{-3t}$$

2.3

Taking the Laplace transform of the differential equation assuming zero initial conditions yields:

$$s^3C(s) + 3s^2C(s) + 7sC(s) + 5C(s) = s^2R(s) + 4sR(s) + 3R(s)$$

Collecting terms,

$$(s^3 + 3s^2 + 7s + 5)C(s) = (s^2 + 4s + 3)R(s)$$

Thus,

$$\frac{C(s)}{R(s)} = \frac{s^2 + 4s + 3}{s^3 + 3s^2 + 7s + 5}$$

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