TABLE 11.6 Key Equations of Chapter 11

Equation Title	Equation Number	Equation
Bilateral z-transform	(11.1)	$\mathscr{Z}_b[f[n]] = F_b(z) = \sum_{n=-\infty}^{\infty} f[n]z^{-n}$
Inverse bilateral z-transform	(11.2)	$\mathscr{Z}_b^{-1}[F_b(z)] = f[n] = \frac{1}{2\pi j}\oint_{\Gamma} F_b(z)z^{n-1}\,dz, \quad j = \sqrt{-1}$
Unilateral z-transform	(11.4)	$\mathscr{Z}[f[n]] = F(z) = \sum_{n=0}^{\infty} f[n]z^{-n}$
Transfer function	(11.44)	$H(z) = \frac{Y(z)}{X(z)} = \frac{b_0 + b_1z^{-1} + \cdots + b_{N-1}z^{-N+1} + b_Nz^{-N}}{a_0 + a_1z^{-1} + \cdots + a_{N-1}z^{-N+1} + a_Nz^{-N}} = \frac{b_0z^N + b_1z^{N-1} + \cdots + b_{N-1}z + b_N}{a_0z^N + a_1z^{N-1} + \cdots + a_{N-1}z + a_N}$
z-transform of right-sided DT exponential	(11.61)	$a^nu[n] \overset{\mathscr{Z}_b}{\longleftrightarrow} \frac{z}{z-a}; \quad \lvert z\rvert > \lvert a\rvert$
z-transform of left-sided DT exponential	(11.64)	$\mathscr{Z}_b[-a^nu[-n-1]] = \frac{-a^{-1}z}{1-a^{-1}z} = \frac{z}{z-a}; \quad \lvert z\rvert < \lvert a\rvert$

The bilateral z-transform is useful in the steady-state analysis of LTI discrete-time systems and in the analysis and design of noncausal systems. Recall that noncausal systems are not realizable in real time. However, noncausal systems are realizable for the digital processing of recorded signals.

The next chapter involves the discrete-time Fourier transform. This transform is the result of applying the Fourier techniques of Chapters 4 through 6 to discrete-time signals, especially to sampled signals.

See Table 11.6.

PROBLEMS

11.1. Express the unilateral z-transforms of the following functions as rational functions. Tables may be used.

(a) 0.3^n

(b) $0.2^n + 2(3)^n$

(c) $3e^{-.7n}$

(d) $5e^{-j.3n}$

(e) $5\cos 3n$

(f) $e^{-.7n}\sin(0.5n)$

11.2. The signals given are sampled every 0.05 s, beginning at $t = 0$. Find the unilateral z-transforms of the sampled functions, with each transform expressed as a rational function.