EECE 5610, Fall 2025 Homework #2, Assigned 09/19/2025, Due 09/26/2025, Turnitin.

1. Problem 2.2.2 text
2. Problem 2.2.3 text
3. Problem 2.6.3 text
4. Problem 2.7.1 text

Problem 2.2.2

2.2-2. The trapezoidal rule (modified Euler method) for numerical integration approximates the integral of a function $x(t)$ by summing trapezoid areas as shown in Fig. P2.2-2. Let $y(t)$ be the integral of $x(t)$.

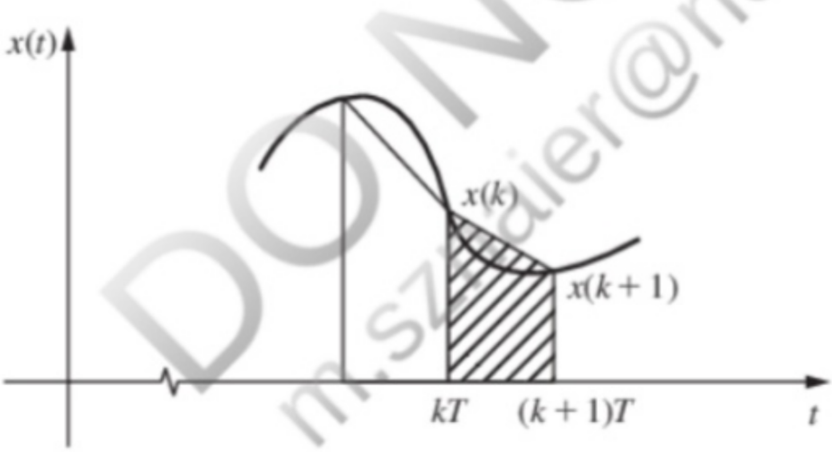

Figure P2.2-2 Trapezoidal rule for numerical integration.

Figure P2.2-2 Full Alternative Text

a. Write the difference equation relating $y[(k+1)T]$, $y(kT)$, $x[(k+1)T]$, and $x(kT)$ for this rule.

b. Show that the transfer function for this integrator is given by

$$\frac{(\ )}{(\ )} = \frac{(\ /2)(\ + 1)}{\ - 1}$$

Problem 2.2.3

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2.2-3.

a. The transfer function for the right-side rectangular-rule integrator was found in **Problem 2.2-1** to be $Y(z)/X(z) = Tz/(z-1)$. We would suspect that the reciprocal of this transfer function should yield an approximation to a differentiator. That is, if $w(kT)$ is a numerical derivative of $x(t)$ at $t = kT$,

$$\frac{W(z)}{X(z)} = \frac{z-1}{Tz}$$

Write the difference equation describing this differentiator.

b. Draw a figure similar to those in **Fig. P2.2-1** illustrating the approximate differentiation.

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c. Repeat part (a) for the left-side rule, where $W(z)/X(z) = T/(z-1)$.

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d. Repeat part (b) for the differentiator of part (c).

Problem 2.6.3

2.6-3. Given the difference equation

$$x(k) - x(k-1) + x(k-2) = e(k)$$

where $e(k) = 1$ for $k \geq 0$.

a. Solve for $x(k)$ as a function of k, using the z-transform. Give the values of $x(0)$, $x(1)$, and $x(2)$.
b. Verify the values $x(0)$, $x(1)$, and $x(2)$, using the power-series method.
c. Verify the values $x(0)$, $x(1)$, and $x(2)$ by solving the difference equation directly.
d. Will the final-value property give the correct value for $x(\infty)$?

Problem 2.7.1

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2.7-1. (a) Find $e(0)$, $e(1)$, and $e(10)$ for

$$E(z) = \frac{0.1}{z(z-0.9)}$$

using the inversion formula.

(b) Check the value of $e(0)$ using the initial-value property.

(c) Check the values calculated in part (a) using partial fractions.

(d) Find $e(k)$ for $k = 0, 1, 2, 3,$ and 4 if $\mathfrak{z}[e(k)]$ is given by

$$E(z) = \frac{1.98z}{(z^2 - 0.9z + 0.9)(z - 0.8)(z^2 - 1.2z + 0.27)}$$

(e) Find a function $e(t)$ which, when sampled at a rate of 10 Hz $(T = 0.1s)$, results in the transform $E(z) = 2z/(z - 0.8)$.

(f) Repeat part (e) for $E(z) = 2z/(z + 0.8)$.

(g) From parts (e) and (f), what is the effect on the inverse z-transform of changing the sign on a real pole?