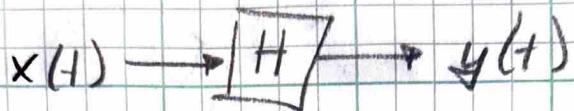


1/23/2026

1/2

- 1.81 Linear, time-invariant system below.  $x(t)$  is periodic with period  $T$ . Shows that  $y(t)$  is also periodic w/  $T$ .



$$x(t) = x(t+T) \rightarrow y(t) = y(t+T) ?$$

$$y(t+T) = H\{x(t+T)\}$$

$$\boxed{y(t+T) = H\{x(t)\} = y(t)} \quad \checkmark$$

1.84

- Block diagram of linear time-varying system below.

$$y(t) = A_0 \cos(\omega_0 t + \phi) x(t)$$



$$A_0 \cos(\omega_0 t + \phi)$$

- a. Demonstrate that the system is linear.

$$x(t) = a x_1(t) + b x_2(t); y(t) = A_0 \cos(\omega_0 t + \phi) [a x_1(t) + b x_2(t)]$$

$$a x_1(t) \rightarrow y_1(t) = A_0 \cos(\omega_0 t + \phi) [a x_1(t)]$$

$$b x_2(t) \rightarrow y_2(t) = A_0 \cos(\omega_0 t + \phi) [b x_2(t)]$$

$$y_1(t) + y_2(t) = y(t) ?$$

$$A_0 \cos(\omega_0 t + \phi) [a x_1(t)] + A_0 \cos(\omega_0 t + \phi) [b x_2(t)]$$

$$\boxed{A_0 \cos(\omega_0 t + \phi) [a x_1(t) + b x_2(t)] = y(t)} \quad \checkmark$$

b.) Demonstrate that the system is time-variant. 2/2

assume  $x(t) = \delta(t)$

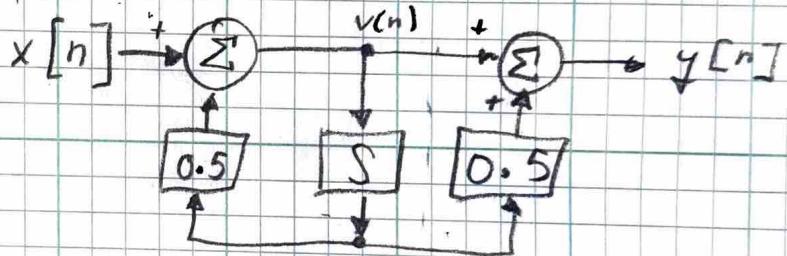
$$y_1(t) = A_0 \cos(\omega_0 t + \phi) \delta(t)$$

$$y_2(t) = A_0 \cos(\omega_0 t + \phi) \delta(t - t_0)$$

$$y_1(t-t_0) = A_0 \cos(\omega_0(t-t_0) + \phi) \delta(t-t_0)$$

$y_1(t-t_0) \neq y_2(t) \Rightarrow$  Time variant!

1.89 Block diagram below, first-order recursive discrete-time filter. Derive expression for  $y[n]$  in terms of  $x[n]$ .



$$\text{Left: } a[n] = x[n] + 0.5a[n-1]$$

$$\text{Right: } a[n] + 0.5a[n-1] = y[n]$$

$$y[n] = x[n] + 0.5a[n-1] + 0.5a[n-1]$$

$$y[n] = x[n] + a[n-1]$$

$$a[n-1] = x[n-1] + 0.5a[n-2]$$

$$a[n-2] = x[n-2] + 0.5a[n-3] \dots$$

$$y[n-1] = x[n-1] + a[n-2]$$

$$a[n-2] = y[n-1] - x[n-1]$$

$$y[n] = x[n] + [x[n-1] + 0.5[y[n-1] - x[n-1]]]$$

$$y[n] = x[n] + x[n-1] + 0.5y[n-1] - 0.5x[n-1]$$

$\boxed{y[n] = x[n] + 0.5x[n-1] + 0.5y[n-1]}$

homework1.m

MATLAB\_review.m

homework3\_question197 mlx

Homework2.m

**Problem 1.97**

A rectangular pulse  $x(t)$  is defined by

$$x(t) =$$

$$10, 0 \leq t \leq 5$$

$$0, \text{ otherwise}$$

Generate  $x(t)$ , using

- (a) A pair of time-shifted step functions
- (b) An M-file (numerically)

**Part (a)**

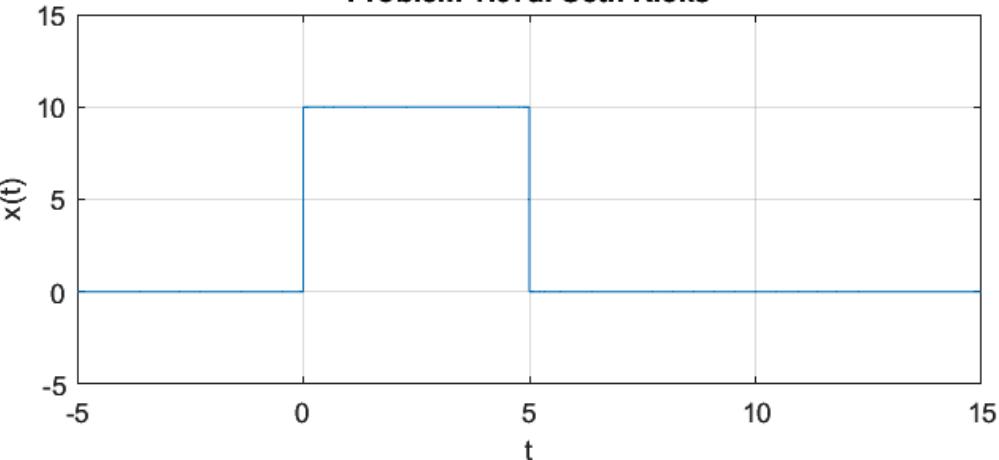
```
1  syms t;
2  subplot(2,1,1)
3  unit_step = 10 * (heaviside(t) - heaviside(t - 5));
4  fplot(unit_step, [-5 15]);
5  ylim([-5 15])
6  title('Problem 1.97a: Seth Ricks');
7  xlabel('t');
8  ylabel('x(t)');
9  grid on;
```

**Part (b)**

```
10 t = -5:0.01:15; % Time
11 x = 10 * (t >= 0 & t <= 5); % True for x>=0 and t <=5, false otherwise
12 subplot(2,1,2)
13 plot(t, x);
14 ylim([-5 15])
15 xlim([-5 15])
16 title('Problem 1.97b: Seth Ricks');
17 xlabel('t');
18 ylabel('x(t)');
19 grid on;
```

Figure

File Edit View Insert Tools Desktop Window Help

**Problem 1.97a: Seth Ricks****Problem 1.97b: Seth Ricks**