EE310

HW 4A: 2.4-33, 2.6-1, 2.7-3

Prob 2.4-33) \( h(t) = -\frac{1}{RC} u(t) \)

Prob 2.6-1) Determine asymptotic stability only.

HW 4B: 3.1-1 (a), 3.1-2 (a), 3.3-3 (a, b), 3.4-2

HW 4C: 3.5-2, 3.6-3, 3.6-5

2.4-33)

a) \( \frac{dy}{dt} = -\frac{1}{RC} x(t) \)

b) \( h(t) = -\frac{1}{RC} u(t), \quad y(t) = -\frac{t}{RC} u(t) \)

The output will grow linearly until the op amp saturates.

2.6-1)

<table>
<thead>
<tr>
<th>System</th>
<th>Roots</th>
<th>Asymptotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>-2, -6</td>
<td>Stable</td>
</tr>
<tr>
<td>(b)</td>
<td>0, -1, -2</td>
<td>Marginally Stable</td>
</tr>
<tr>
<td>(c)</td>
<td>0, 0, (-j\sqrt{2}, +j\sqrt{2})</td>
<td>Unstable</td>
</tr>
<tr>
<td>(d)</td>
<td>-1, +1, +5</td>
<td>Unstable</td>
</tr>
</tbody>
</table>

2.7-3)

a) \( T_r = T_h = 0.1 \text{ ms} \)

b) \( f_c = 1/T_r = 10 \text{ kHz} \)

c) \( R < 1/T_h = 10 \text{ kpps} \)

3.1-1)

a) \( E_x = 19 \)

3.1-2)

a) \( P_x = \frac{19}{6} = 3.167 \)

3.3-3)
a) \[
x = @(n) \text{delta}(1, n - 2) - \text{delta}(1, n - 6);
n = -2:8; \text{stem}(n,x(n))
\]

b) \[
x = @(n) n.*(\text{delta}(1, n) - \text{delta}(1, n - 7));
n = -2:8; \text{stem}(n,x(n))
\]

3.4-2) \[
p[n+1] - 1.02 p[n] = i[n]
\]

3.5-2) \[
\]
General solution: \[
y[n] = (-0.2)^n - 16(8)^n
\]

3.6-3) \[
y[n] = 2(2^{n/2}) \cos\left(\frac{\pi}{4} n\right) = (2)^{n/2} \cos\left(\frac{\pi}{4} n\right)
\]

3.6-5) a) \[
\]
There is no input. There is only initial state (non-zero initial conditions).

b) \[
\gamma_1 = \frac{1 - \sqrt{5}}{2} \approx -0.618, \quad \gamma_2 = \frac{1 + \sqrt{5}}{2} \approx 1.618
\]
The system is not stable since \(|\gamma_2| > 1\).
\[ f[n] = \left( \frac{\sqrt{5}+5}{10} \right)^n - \left( \frac{\sqrt{5}-5}{10} \right)^n \]

\[ f[50] = 7,778,742,049 \]

\[ f[1000] = 2.686381 \times 10^{208} \]

We can use Octave's `filter` function to find the output of this DT system. The following line of code returns the 50th element in the series:

```octave
>> filter(0, [1 -1 -1], zeros(1, 50), [0 1])(end)
ans = 7.7787e+009
```

The first and second arguments are the \( b \) and \( a \) coefficients in the DT system:

\[ a_0 y[n] + a_1 y[n-1] + ... = b_0 x[n] + b_1 x[n-1] + ... \]

The DT equation for the system in this problem is:

\[ y[n] - y[n-1] - y[n-2] = 0 \]

so the \( a \) input is 0 and the \( b \) input is \([1 -1 -1]\). The third argument is the system input. In this example the input is 0. The fourth argument is the initial state of the system. The `filter` function returns an output vector of the same length as the input. The `(end)` at the end of the line causes just the last element of the output vector to be displayed.

Similarly the following line returns the 1000th element:

```octave
>> filter(0, [1 -1 -1], zeros(1, 1000), [0 1])(end)
ans = 2.6864e+208
```

The Octave results verify the results obtained in part c).