Solutions to EE3210 Quiz 5 Problems

Problem 1:

(a) The system is not memoryless. For example, when $t = -1$, we have $h(-1) = e \neq 0$.

(b) The system is not causal. For example, when $t = -1$, we have $h(-1) = e \neq 0$.

(c) The system is not stable, since $\int_{-\infty}^{+\infty} |h(t)|\, dt = \int_{-\infty}^{+\infty} e^{-t} dt = \infty$.

Problem 2:

(a) The linear constant-coefficient difference equation that describes the relationship between the input $x[n]$ and the output $w[n]$ of system S_1 is

$$w[n] = w[n-1] + x[n]. \tag{1}$$

(b) The linear constant-coefficient difference equation that describes the relationship between the input $w[n]$ and the output $y[n]$ of system S_2 is

$$y[n] = y[n-1] + y[n-2] + w[n]. \tag{2}$$

(c) From (2), we obtain

$$w[n] = y[n] - y[n-1] - y[n-2] \tag{3}$$

and hence

$$w[n-1] = y[n-1] - y[n-2] - y[n-3]. \tag{4}$$

Then, substituting $w[n]$ and $w[n-1]$ in (1) with (3) and (4), respectively, we have

$$y[n] - y[n-1] - y[n-2] = y[n-1] - y[n-2] - y[n-3] + x[n]$$

and therefore

$$y[n] = 2y[n-1] - y[n-3] + x[n].$$