DATE: April 07, 2018 – Duration: 90 minutes

Question 1 (25 marks)

a) The signal $x(t)$ is given by

$$x(t)=\begin{cases}4 & 0\le t\le 6\\ -2 & -4\le t<0\\ 0 & \text{otherwise}\end{cases}$$

Calculate the energy of the signal $x(t)$. Sketch the signals $x(t)$, $x(t-2)$, $x(-t-2)$, $x(2t-2)$ and describe briefly in words how each of the signals can be derived from the original signal x(t). Express the signal $x(t)$ in terms of the unit step signals.

b) The discrete-time signal is defined as $x[n]=0.5^n u(n)$. Sketch the signal $x[n]$ and determine its energy.

Question 2 (25 marks)

Discuss the linearity and time-invariance properties of the following systems

a) $y(t)=x(2t-1)+x(t)$

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b) $y(t)=3x(t-1)+2$

Question 3 (25 marks)

a) The input and output relationship of a downsampling system is defined as $y[n]=x[2n]$. Given the input $x[n]=[4,-4,3,1,3,4,5]$. Determine the output $y[n]$. Is this system time-invariant? Explain your answer.

b) The discrete-time LTI system has the unit impulse response $h[n]=[3,0,-2]$. Let $x[n]$ be the system input and $y[n]$ be the system output. Write the equation to describe the input-output relationship.

c) With the system in Question 3b, find the output $y[n]$ for the input $x[n]=[1,2,0,-1,-2]$.

Question 4 (25 marks)

An LTI analog system has the following unit impulse response

$$h(t)=3e^{-2t}u(t)$$

a) Find the output $y(t)=x(t)*h(t)=\int_{-\infty}^{+\infty}x(\tau)h(t-\tau)d\tau$ for the input $x(t)=2e^{-4t}u(t)$.

b) Using the LTI properties and the results in Question 4a, find the response of the system for the input $x(t)=e^{-4t}[u(t)-u(t-2)]$.