Signals and Systems

Assignment 6

Spring 2020

MohammadKhalaji76@gmail.com - JaliliA370@gmail.com
Telegram Channel: @SignalsAndSystems99Spring

Question 1

Let $x(t)$ be a signal with Nyquist rate $= \omega_0$. Determine the Nyquist rate for the following signals.

(a) $x(t) + x(t-5) - x(t+2\sqrt{2})$

(b) $\frac{d^k}{dt^k}x(t)$ for $k \in Z$ and $k \geq 2$

(c) $x^2(t)$

(d) $x(t)sin(\omega_p t)$

Question 2

Determine the Nyquist rate for the signals that can be sampled properly.

(a) $x(t) = e^{-6t}u(t)$

(b) $x(t) = 1 + sin(50\pi t) + sin(100\pi t)cos(125\pi t)$

(c) $x(t) = u(t) - u(t-6)$

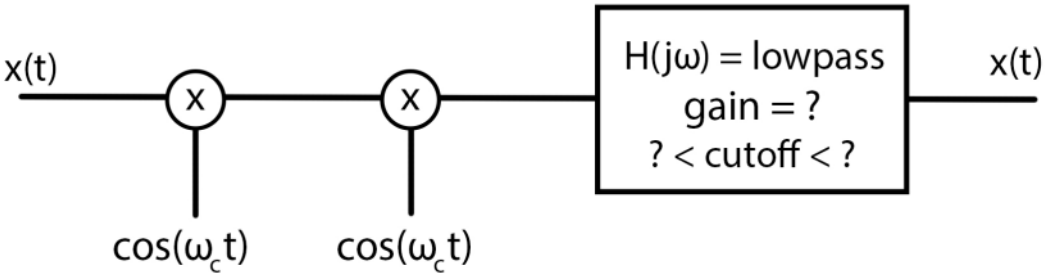
(d) $x(t) = \frac{sin(600\pi t)}{\pi t}$

Question 3

Try sampling the signal from Question 2 part d with an invalid Nyquist rate. Sketch $X_p(j\omega)$, also sketch it using a valid Nyquist rate.

Question 4

Consider a band-limited signal $x(t)$, where $X(j\omega)$ is non-zero for only $-250\pi < \omega < 250\pi$ and looks like a symmetric triangle where $X(j0) = A$. Answer the following questions in a way that makes this system act like a modulation-demodulation system (= final output is also $x(t)$).



(a) What is the valid range for ω_c? Choose an arbitrary value from that range and proceed to the next parts.

(b) What is the valid range for $H(j\omega)$'s cutoff?

(c) Determine the valid value for $H(j\omega)$'s gain.

Question 5

Determine the Laplace transform and the ROC for each of the following signals:

(a) x(t) $= e^{-2t}u(t) + e^{-3t}u(t)$

(b) x(t) $= te^{-3|t|}$

(c) x(t) $= \begin{cases} 1, & 0 \leq t \leq 1 \\ 0, & O.W \end{cases}$

(d) x(t) $= \delta(2t) + u(3t)$

Question 6

Determine the function of time, x(t), for each of the following Laplace transforms and their associated regions of convergence:

(a) $\dfrac{1}{s^2+4} \quad \Re\{s\} > 0$

(b) $\dfrac{s}{s^2+4} \quad \Re\{s\} < 0$

(c) $\dfrac{s+1}{(s+1)^2+9} \quad \Re\{s\} < -1$

(d) $\dfrac{(s+1)^2}{s^2-s+1} \quad \Re\{s\} > \dfrac{1}{2}$