Answers Mid-term exam EE2S31
Signaalbewerking

May 18th, 2016

Answer each question on a **separate sheet**. Make clear in your answer how you reach the final result; the road to the answer is very important. Write your name and student number on each sheet. It is allowed to answer in Dutch or English.

Question 1

(a)

$$c \int_0^\infty \int_0^y e^{-2x} e^{-3y} dx dy = \frac{1}{15} c = 1$$

c equals thus $c = 15$.

(b)

$$c \int_{10}^\infty \int_0^y e^{-2x} e^{-3y} dx dy = \frac{c}{2} \left(\frac{1}{3} e^{-30} - \frac{1}{5} e^{-50} \right)$$

(c)

$$c \int_x^\infty e^{-2x} e^{-3y} dy = \frac{c}{3} e^{-5x}$$

(d) $f_{X|Y}(x|y) = f_{X,Y}(x,y)/f_X(x)$.

(e) $f_{X|Y}(x|y)$ depeds on y and thus are X and Y not independent.

Question 2

(a) This is a uniform pdf and should integrate to one. Thus, $c = 1/3$

(b)

(c) $E[X(t)] = t^2 E[A] = t^2 \frac{3}{2}$.

(d) $R_X(t, \tau) = 3t^2(t + \tau)^2$

(e) Non-stationary, as the expected value and the autocorrelation function depend on time t.

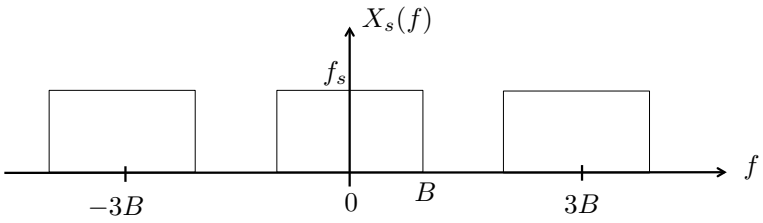
Question 3

a) The signal is continuous-time since the spectrum is non-periodic.

b) The signal is non-periodic since the spectrum is continuous.

c) $x_s(n) = x(nT_s)$.

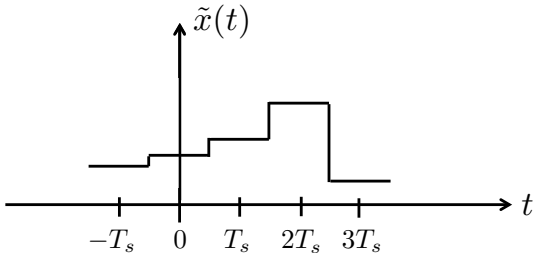
d)



e) $f_s > 2B$. The reconstruction formula is given by

$$\tilde{x}(t) = \sum_{n=-\infty}^{\infty} x_s(n) g(t - nT_s).$$

f)



g)

$$G(f) = \int_{-T_s/2}^{T_s/2} e^{j2\pi ft} dt = \frac{1}{j2\pi f} \, e^{j2\pi ft} \Big|_{-T_s/2}^{T_s/2} = \frac{1}{\pi f} \sin(\pi f T_s) = T_s \, \mathrm{sinc}(\pi f T_s).$$

h) The product of the since functioning and the plot obtained in d).

i) In general not. Only when $f_s \to \infty$ the reconstruction error will vanish.