University of Maryland
Master's in Telecommunications Program
Sample Placement Exam Questions for ENTS 622

ENTS 622: Introduction to Digital Communications Systems

1. Say $Y(t) = X(t) + A$, where $X(t)$ is a random process and A is a constant, known DC component. Then, please choose the best answer:

   (a) $Y(t)$s autocorrelation function will contain a constant component equal to A.

   (b) $Y(t)$s autocorrelation function will contain a constant component equal to A^2.

   (c) $Y(t)$s power spectral density will be shifted by A in the positive direction with respect to $X(t)$s.

   (d) $Y(t)$s power spectral density will contain a constant component equal to $A\delta(f+A)$ (where $\delta(\cdot)$ is the Dirac delta function).

2. Which is the Fourier transform of $rect(\frac{t}{T}) = \begin{cases} 1, |t| \leq \frac{T}{2} \\ 0, otherwise \end{cases}$

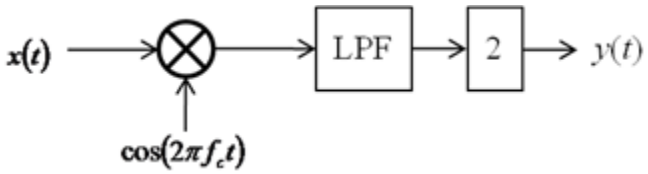
   (a) $T\ rect(fT)$

   (b) $e^{-j2fT}\ sinc^2(f)$

   (c) $\frac{rect(f)}{2}(\delta(f-T) + \delta(f+T))$

   (d) $T\ sinc(fT)$

3. In the illustration below, $x(t)$ is a real narrowband signal, with bandwidth $2W$ and carrier frequency $f_c \gg W$. The low-pass filter (LPF) has bandwidth W and a gain of 1.



Then $y(t)$ is

   (a) the complex envelope of $x(t)$.

   (b) the quadrature component of $x(t)$.

   (c) the in-phase component of $x(t)$.

   (d) the envelope of $x(t)$.

4. Concerning DPSK (Differential Phase Shift Keying) and PSK (Phase Shift Keying) modulation, we may say that:

   (a) The symbol error rate for DPSK is less than for PSK, for equal SNR.

   (b) PSK is a constant envelope modulation method.

   (c) DPSK uses non-coherent demodulation.

   (d) Both (b) and (c).

5. The entropy of a discrete memoryless source

   (a) is a lower bound on the average codeword length.

   (b) is equal to the required bandwidth of a communication channel.

   (c) is an upper bound on the SNR of a detector output.

   (d) is zero if and only if none of the symbols' probabilities are equal to 1.

6. If $X = 48$ in absolute linear scale, then approximately what is X decreased by 6dB, in absolute linear scale?

   (a) 6

   (b) 12

   (c) 18

   (d) 24

7. If we denote the natural logarithm as $\ln(\cdot)$, and the Dirac delta function as $\delta(\cdot)$, then please, choose which one is correct:

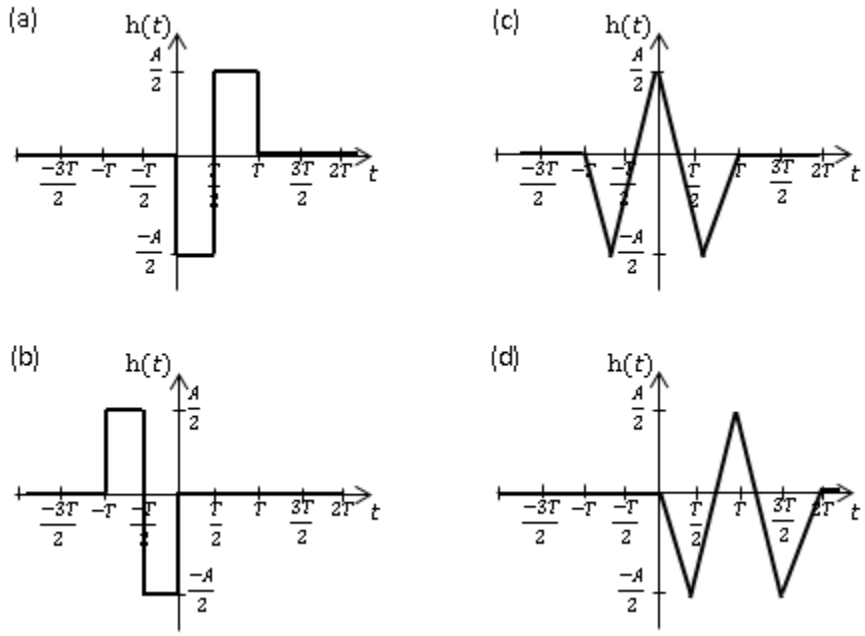
   (a) $\int_{-20}^{-1} \frac{3\delta(x+3)}{e^{-x}} dx = \frac{3}{e^3}$

   (b) $\int_{0}^{\infty} \delta(t+\frac{1}{2}) e^{-t^2} dt = \frac{\sqrt{\pi}}{2}$

   (c) $\int_{-2}^{-1} (se^s + 1)\, \delta(s-\frac{1}{2}) ds = -\frac{1}{e^2}$

   (d) $\int_{1}^{2} \delta(w+1) \frac{-3}{w^2} dw = -3 \cdot \ln(2)$

8. Consider the signal defined over the signaling interval, T, as $s(t) = \begin{cases} \frac{A}{2}, \text{for } t \in [0, \frac{T}{2}] \\ \frac{-A}{2}, \text{for } t \in [\frac{T}{2}, T] \\ 0, otherwise \end{cases}$ Please, select the impulse response for the matched filter of $s(t)$.



9. If the impulse response of a root raised cosine filter is convolved with itself, we obtain a

   (a) Dirac delta impulse response.
   (b) rectangular impulse response.
   (c) raised cosine impulse response.
   (d) triangular impulse response.

10. If a random process is ergodic, it means that

   (a) its power spectral density does not exist.
   (b) its second order statistics are time-invariant.
   (c) its expected value is zero.
   (d) its statistical averages can be determined from its sample averages.

The answers for these sample questions are (b), (d), (c), (d), (a), (b), (a), (a), (c), and (d).