Assignment 1

Digital Communication System-I

April 2023

Please answer the following questions:

1. Statement 1: In any communication system, the unmodulated information sequence is sent for the communication channel.

   Statement 2: The source encoder minimizes the number of bits per unit time required to represent the source output.

   Which of the following option is true?

   (a) Statement 1 is correct.

   (b) Statement 2 is correct.

   (c) Both statement 1 and statement 2 are correct.

   (d) None of the above.

2. Consider any encoded sequence $\mathbf{c}$ in a linear block code. Assume the information sequence $\mathbf{x} = 1010$ is padded with 3 redundant bits, and thus making an encoded sequence $\mathbf{c} = 1010111$. Find out the code-rate of the of the code?

   (a) 0.5714

   (b) 0.4286

   (c) 0.7500

   (d) 0.3750

3. Let the signal be represented by $f(t) = \cos t$. Assume that the signal $f(t)$ passes through a transmission link and produces an output $g(t) = \alpha f(t) + n(t)$, where $\alpha = 0.3$ and $|n(t)| \leq 0.2$. What is the maximum amplitude of the signal waveform?

   (a) 1

   (b) 0.6

   (c) 0.4

   (d) 0.5

4. Compute the energy of the signal $f(t) = \text{sinc}(t)$

   (a) 2

   (b) 1

   (c) 0.5

   (d) 0.25

5. For any practical communication channel what is the most suitable distribution to model the additive noise at the receiver end?

   (a) Rayleigh distribution

   (b) Gaussian distribution

   (c) Uniform distribution

   (d) Exponential distribution

6. What will be the output waveform if Hilbert transform is applied to the signal $f(t) = \cos 2t$

   (a) $-\cos 2t$

   (b) $-\sin 2t$

   (c) $\sin 2t$

   (d) $-\frac{1}{\pi t}$

7. Determine the nature of the following signal

$$x(t) = \begin{cases} 2t^{-\frac{1}{4}}, & t > 0 \\ 0, & t \leq 0. \end{cases}$$

   (a) $x(t)$ is a power signal.

   (b) $x(t)$ is an energy signal.

   (c) $x(t)$ is neither a power nor an energy signal.

   (d) None of the above.

8. Consider the following signal

$$f(t) = \frac{\sin 2\pi t}{2\pi t}.$$

   Statement 1: It is a real periodic signal.

   Statement 2: It is a deterministic continuous signal.

   (a) Statement 1 is correct.

   (b) Statement 2 is correct.

   (c) Both statement 1 and statement 2 are correct.

(d) None of the above.

9. Compute the 99% energy bandwidth of the signal $f(t) = \text{sinc}^2(t)$

   (a) 0.7286 Hz

   (b) 0.9900 Hz

   (c) 0.9536 Hz

   (d) 0.7846 Hz

10. Which of the following statement is not true for a real signal $x(t)$. The notations used are same as in the lecture

    (a) $x_+(t) = \frac{1}{2}x(t) + \frac{j}{2}\hat{x}(t)$

    (b) $x_l(t) = \text{Re}\left[x(t)e^{j2\pi f_0 t}\right]$

    (c) $x_l(t) = (x(t)\cos 2\pi f_0 t + \hat{x}(t)\sin 2\pi f_0 t) + j\,(\hat{x}(t)\cos 2\pi f_0 t - x(t)\sin 2\pi f_0 t)$

    (d) All of these are correct