Digital Communication (10EC/TE61) *

Assignment # 5: Baseband Shaping for Signal Transmission

Date of Issue: April 13, 2017

Submission Due: April 26, 2017

Instructions:

- ANSWER NEATLY AND LEGIBLY on **A4 sheets only** and not on sheets torn from a book.
- Sketch diagrams wherever relevant. Explain your notations explicitly and clearly.
- An incomplete assignment is not acceptable for submission.
- Once you submit your assignment, you will be expected to answer all the questions there INDEPENDENTLY. You may be asked to answer any question of the assignment in the class.
- Leave clear left margin on every sheet.
- On the top of your first sheet, write your Name, Class, Section, USN, Due Date and Date of Submission.
- Page number your answer sheets sequentially. **(1/22), (2/22),** ······ **(22/22)**

Assignment Questions

1. Discuss the various properties of line codes.
2. For the binary sequence **01011100** draw the digital format waveform corresponding to
   (a) NRZ Unipolar
   (b) RZ Unipolar
   (c) NRZ Polar
   (d) RZ Polar
   (e) NRZ Bipolar
   (f) Split Phase Manchester Coding
3. For the binary sequence **10110100** draw the digital format waveform corresponding to
   (a) NRZ Unipolar
   (b) RZ Unipolar
   (c) NRZ Polar
   (d) RZ Polar
   (e) NRZ Bipolar
   (f) Split Phase Manchester Coding

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4. A randomly generated data stream consists of equiprobable zeros and ones. It is encoded into a polar waveform with each binary symbol being defined as follows.

$$s(t) = \begin{cases} cos(\frac{\pi t}{T_b}), & -T_b/2 \leq t \leq T_b/2 \\ 0, & \text{elsewhere.} \end{cases}$$

   (a) Sketch the waveform assuming that data stream is **00101110**.

   (b) Derive an expression for the power spectral density of this scheme and compare it with the PSD of NRZ polar waveform with pulse duration T_b.

5. Show that for the bipolar format, the autocorrelation function $R_A(n) = E[A_k A_{k-n}]$ is zero for $n > 1$, where A_k is the k^{th} random variable representing k^{th} bit of input binary sequence. Assume statistically independent and equally likely message bits.

6. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the **NRZ unipolar** format representation of the binary sequence. Plot the normalized power spectrum.

7. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the **NRZ polar** format representation of the binary sequence. Plot the normalized power spectrum.

8. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the **RZ unipolar** format representation of the binary sequence. Plot the normalized power spectrum.

9. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the **RZ polar** format representation of the binary sequence. Plot the normalized power spectrum.

10. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the **NRZ bipolar** format representation of the binary sequence. Plot the normalized power spectrum.

11. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the **RZ bipolar** format representation of the binary sequence. Plot the normalized power spectrum.

12. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for **Manchester** format representation of the binary sequence. Plot the normalized power spectrum.

13. Explain the basic elements of a baseband binary PAM system.

14. What is ISI? Derive an expression for Nyquist pulse shaping criterion for distortionless base band binary transmission. Mention its practical limitations.

15. A multilevel digital communication system transmits one of the sixteen possible levels over the channel every 0.8 msec. What is the minimum number of bits corresponding to each level? Find baud and the bit rate.

16. Explain raised cosine spectrum solution to reduce **ISI**.

17. A binary PAM wave is required to be transmitted via a channel having bandwidth of 75 kHz. The bit duration is 10 μ sec. Find a raised cosine pulse spectrum that satisfies these requirements.

18. What is correlative coding? Explain duobinary coding with and without precoding.

19. Explain modified duobinary coding.

20. A telephone cable of bandwidth 3 kHz is used to transmit binary data. Calculate the data rate that can be obtained if we use

    (a) Polar signal with half width rectangular pulses
    (b) Polar signal with full width pulses
    (c) Polar signal using raised cosine pulses with roll-off factor of 0.25.

21. What is equalization? Explain adaptive equalization for data transmission.

22. Explain eye pattern. Discuss how eye pattern can be used to analyse the performance of a data transmission system.

23. Draw the circuit diagram to generate bipolar representation of input binary sequence and use this circuit to obtain bipolar representation for the sequence **011100101**.

24. For the binary sequence **10110100**, draw the 4-ary signalling format waveform.

25. A computer puts out binary data at the rate of 64 kbps. The output is transmitted using a base band binary PAM system that is designed to have a raised cosine spectrum. Determine the transmission bandwidth required for each of the following roll off factors.

    (a) $\alpha = 0$
    (b) $\alpha = 0.5$
    (c) $\alpha = 0.75$
    (d) $\alpha = 1$

26. A computer puts out binary data at the rate of 50 kbps. The output is transmitted using a base band binary PAM system that is designed to have a raised cosine spectrum. Determine the transmission bandwidth required for each of the following roll-off factors.

    (a) $\alpha = 0.2$
    (b) $\alpha = 0.4$
    (c) $\alpha = 0.8$
    (d) $\alpha = 1$

27. The binary data **0101011001** is applied to a duo binary system.

    (a) Construct the Duobinary coder output and the corresponding receiver output without a precoder.
    (b) Suppose that due to error in transmission, the level produced by the second digit is reduced to zero. Construct the new receiver output.

28. The binary data **011100101** is applied to a modified Duobinary system.

    (a) Construct the modified Duobinary coder output without precoder.

(b) Suppose that due to error in transmission, the level produced by the third digit is reduced to zero. Construct the new receiver output.

29. The binary data **0101011001** is applied to a modified Duobinary system.
    (a) Construct the modified Duobinary coder output without precoder.
    (b) Suppose that due to error in transmission, the level produced by the third digit is reduced to zero. Construct the new receiver output.

30. The binary data **011100101** is applied to a Duobinary system with precoder.
    (a) Construct the precoder, Duobinary coder and the corresponding receiver output for initial bit **0** and for initial bit **1**.
    (b) Suppose that due to error in transmission, the level produced by the second digit is reduced to zero. Construct the new receiver output.

Topics of this assignment are included in Internal Assessment Test II.
Q.1 to Q.16 must be answered/solved by all. For Q.17 to Q.30, EVEN USN students to solve/answer EVEN numbered questions and ODD USN students to solve/answer ODD numbered questions.
Submission Due: April 26, 2017
Good Luck!