

**Department of Electrical Engineering**  
**Final – Term Assignment Spring 2020**

**Date: 24/06/2020**

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**Course Details**

**Course Title:** Advance Computer Networks  
**Instructor:** \_\_\_\_\_

**Module:** \_\_\_\_\_  
**Total Marks:** 50

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**Student Details**

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Q1.	(a)	<ol style="list-style-type: none"><li>1. Assume we need to download text documents at the rate of 100 pages per minute. What is the required bit rate of the channel?</li><li>2. A digitized voice channel is made by digitizing a 4-kHz bandwidth analog voice signal. We need to sample the signal at twice the highest frequency (two samples per hertz). We assume that each sample requires 8 bits. What is the required bit rate?</li><li>3. What is the bit rate for high-definition TV (HDTV)?</li><li>4. The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with -0.3 dB/km has a power of 2 mW, what is the power of the signal at 5 km?</li><li>5. An analog signal carries 4 bits per signal element. If 1000 signal elements are sent per second, find the bit rate.</li></ol>	Marks 20
Q2.	(a)	<p>Draw the graph of the NRZ-L, NRZ-S, RZ-AMI, Dicode NRZ Dicode RZ schemes using the following data stream, assuming that the last signal level has been positive.</p> <p style="text-align: center;">1 0 1 1 0 0 0 1 1 0 1</p>	Marks 20
Q3.	(a)	<ol style="list-style-type: none"><li>1. A signal is sampled. Each sample requires at least 12 levels of precision (+0 to +5 and -0 to -5). How many bits should be sent for each sample?</li><li>2. What sampling rate is needed for a signal with a bandwidth of 10,000 Hz (1000 to 11,000 Hz)?</li></ol>	Marks 10

**Question # 01:**

1. Assume we need to download text documents at the rate of 100 pages per minute. What is the required bit rate of the channel?

Solution

A page is an average of 24 lines with 80 characters in each line. If we assume that one character requires 8 bits, the bit rate is

$$100 \times 24 \times 80 \times 8 = 1,636,000 \text{ bps} = 1.636 \text{ Mbps}$$

2. A digitized voice channel is made by digitizing a 4-kHz bandwidth analog voice signal. We need to sample the signal at twice the highest frequency (two samples per hertz). We assume that each sample requires 8 bits. What is the required bit rate?

Solution

The bit rate can be calculated as

$$2 \times 4000 \times 8 = 64,000 \text{ bps} = 64 \text{ kbps}$$

3. What is the bit rate for high-definition TV (HDTV)?

Solution

HDTV uses digital signals to broadcast high quality video signals. The HDTV Screen is normally a ratio of 16 : 9 (in contrast to 4 : 3 for regular TV), which means the screen is wider. There are 1920 by 1080 pixels per screen, and the screen is renewed 30 times per second. Twenty-four bits represents one color pixel. We can calculate the bit rate as

$$1920 \times 1080 \times 30 \times 24 = 1,492,992,000 \text{ or } 1.5 \text{ Gbps}$$

The TV stations reduce this rate to 20 to 40 Mbps through compression.

4. The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with -0.3 dB/km has a power of 2 mW, what is the power of the signal at 5 km?

Solution:

The loss in the cable in decibels is  $5 \times (-0.3) = -1.5$  dB. The power is calculated as:

$$\text{dB} = 10 \log_{10} P_2/P_1 = -1.5$$

$$P_2/P_1 = 10^{-0.15} = 0.71$$

$$P_2 = 0.71P_1 = 0.7 \times 2 = 1.4 \text{ mW}$$

5. An analog signal carries 4 bits per signal element. If 1000 signal elements are sent per second, find the bit rate.

Solution:

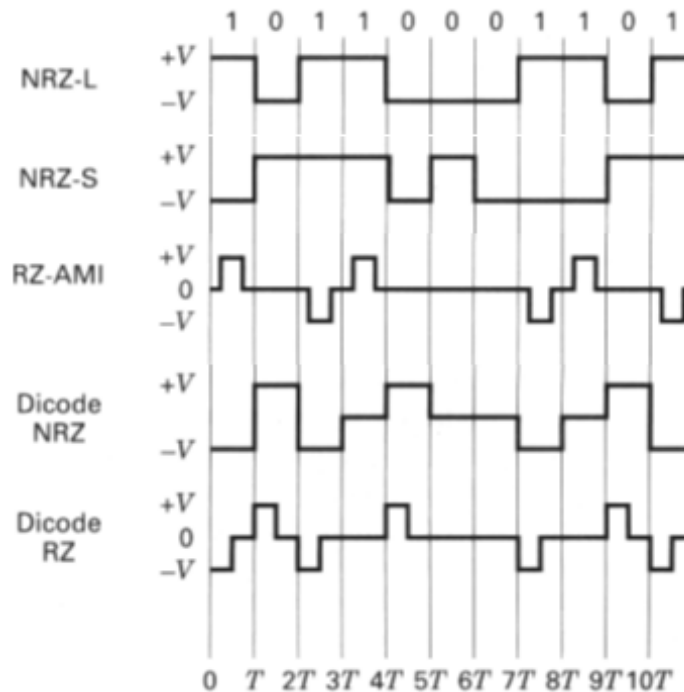
$$r = 4 \text{ S} = 1000, \text{ and } N = ?$$

$$S = N \times 1/r = N = S \times r = 1000 \times 4 = 4000 \text{ bps}$$

### Question # 02

Draw the graph of the NRZ-L, NRZ-S, RZ-AMI, Dicode NRZ, Dicode RZ schemes using the following data stream, assuming that the last signal level has been positive.

1 0 1 1 0 0 0 1 1 0 1



### Question # 03

1. A signal is sampled. Each sample requires at least 12 levels of precision (+0 to +5 and -0 to -5). How many bits should be sent for each sample?

Solution:

We need 4 bits; 1 bit for the sign and 3 bits for the value. A 3-bit value can represent  $2^3 = 8$  levels (000 to 111), which is more than what we need. A 2-bit value is not enough since  $2^2 = 4$ . A 4-bit value is too much because  $2^4 = 16$ .

2. What sampling rate is needed for a signal with a bandwidth of 10,000 Hz (1000 to 11,000 Hz)?

Solution:

The sampling rate must be twice the highest frequency in the signal:

$$\text{Sampling rate} = 2 \times (11,000) = 22,000 \text{ samples/s}$$