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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING**

**TEST 1**

**Winter Semester:** 2021 - 22

**Course Code:** ECE 212

**Course Name:** Digital Communication

**Program & Sem:** B. Tech & VI Sem

**Date:** 25<sup>th</sup> April 2022

**Time:** 1:30 pm to 2:30 pm

**Max Marks:** 30 Marks

**Weightage:** 15%

**Instructions:**

- (i) Read the all questions carefully and answer accordingly.
- (ii) Non-Programmable Scientific Calculators permitted

**Part A [Memory Recall Questions]**

**Answer all the Questions. Each question carries 01 marks.**

**(10Qx 1M= 10M)**

1. A signal, which contains band of frequencies not adjacent to zero, is known as band pass signal. The spectrum of the band pass signal spans from 20 kHz to 30 kHz. The signal can be recovered ideally from the sampled values when the sampling rate is at least\_\_\_\_\_. (C.O.No.1) [Knowledge Level]
2. Low pass signals are low frequency signals, it has upper cutoff frequency where as bandpass signals has certain range of frequencies having upper cutoff and lower cutoff frequencies. Identify the type (Bandpass/Lowpass) of the signal which extends from 200Hz to 3200Hz. (C.O.No.1) [Knowledge Level]
3. The sampling theorem specifies the minimum-sampling rate at which a continuous-time signal needs to be uniformly sampled so that the original signal can be completely recovered or reconstructed by these samples alone. The minimum sampling frequency for the signal mentioned in Question No.2 is\_\_\_\_\_. (C.O.No.1) [Knowledge Level]
4. An ideal impulse signal is a signal that is zero everywhere but at the origin ( $t = 0$ ), it is infinitely high. The difference between Ideal and Practical sampling is\_\_\_\_\_. (C.O.No.1) [Knowledge Level]
5. In digital communication system input signals should be in digital form so that DSP can be employed on the signals. Identify the process of converting continuous time signal to a discrete time signal \_\_\_\_\_. (C.O.No.1) [Knowledge Level]

6. In signal processing, the Nyquist rate, named after Harry Nyquist, specifies a sampling rate (in units of samples per second or hertz, Hz) equal to twice the highest frequency (bandwidth) of a given function or signal. Find the Nyquist rate for a signal  $x(t)=5\cos(2\pi*500t)$  \_\_\_\_\_.  
(C.O.No.1) [Knowledge Level]
7. The Nyquist interval for the signal mentioned in Question No.6 is\_\_\_\_\_.  
(C.O.No.1) [Knowledge Level]
8. Quadrature sampling of band pass signal is an extension of the sampling of lowpass signals. In this scheme rather than sampling a bandpass signal directly, it is represented as a combination of\_\_\_\_\_ and \_\_\_\_\_ components.  
(C.O.No.1) [Knowledge Level]
9. When the sampling rate is not large enough, then overlapping among adjacent spectrum will occur, and this results in distortion. In this case, the original signal cannot be recovered from the sampled signal. This result in phenomenon called as\_\_\_\_\_.  
(C.O.No.1) [Knowledge Level]
10. Time-division multiplexing (TDM) is a method of transmitting and receiving independent signals over a common channel by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern. In PAM-TDM system the sampling is done by\_\_\_\_\_.  
(C.O.No.1) [Knowledge Level]

### Part B [Thought Provoking Questions]

**Answer all the Questions. Each question carries 10 marks.**

**(1Qx10M=10M)**

11. Consider a scenario where Three FM broadcasting stations such as Radio City 91.1 FM, Radio Indigo 91.9 FM, Big 92.7 FM are utilizing the available bandwidth of 88MHz to 108MHz for their broadcasting. Identify the multiplexing technique utilized by the 3 FM stations to share a common channel. Explain it with the relevant diagrams.  
(C.O.No.1) [Knowledge Level]

### Part C [Problem Solving Questions]

**Answer all the Questions. Each question carries 05 marks.**

**(2Qx5M=10M)**

12. A signal  $g(t)=2\cos 400\pi t+6\cos 640\pi t$  is ideally sampled at  $f_s=640\text{kHz}$ . If the cutoff frequency of the reconstruction filter is 400Hz; what frequency components will appear at the filter output.  
(C.O.No.1) [Knowledge Level]
13. A signal  $m_1(t)$  is band limited to 3.6kHz and three other signals  $m_2(t)$ ,  $m_3(t)$  and  $m_4(t)$  each bandlimited to 1.2kHz. These signals are to be transmitted by TDM; Assume each signal is to be sampled at Nyquist rate. Setup a scheme to determine the minimum transmission bandwidth of the channel.  
(C.O.No.1) [Knowledge Level]



**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING**

**TEST –1**

<b>Winter Semester</b>	<b>: 2021 – 22</b>	<b>Date</b>	<b>: 25-04-2022 [Monday]</b>
<b>Course Code</b>	<b>: ECE 212</b>	<b>Time</b>	<b>: 1.30 pm to 2.30 pm</b>
<b>Course Name</b>	<b>: Digital Communication</b>	<b>Max Marks</b>	<b>: 30 Marks</b>
<b>Program &amp; Sem</b>	<b>: B.Tech (ECE) &amp; VI</b>	<b>Weightage</b>	<b>: 15%</b>

**Instructions:**

- i. Read Questions carefully and answer accordingly*
- ii. Non-Programmable Scientific Calculators permitted*

**Part A [Memory Recall Questions]**

**Answer all the Questions. Each question carries 2 marks. (5Qx 2M= 10M)**

1. To convert a signal from continuous time to discrete time, a process called sampling is used. If the top of the samples remains constant and equal to the instantaneous value of the modulating signal at the start of the sampling is called \_\_\_\_\_ sampling and the sampling in which the top of sampled pulses retains their natural shape during the sampling interval is called \_\_\_\_\_ sampling.  
[2M] (C.O.No.1) [Knowledge Level]
2. Sampling is the process of measuring the instantaneous values of continuous-time signal in a discrete form. The sampling rate of  $2W$  samples per second for a signal bandwidth  $W$ Hz is called the \_\_\_\_\_ and  $1/2W$ sec is called the \_\_\_\_\_.  
[2M] (C.O.No.1) [Knowledge Level]
3. Nyquist Rate is the minimum sampling frequency needed to detect the original signal without distortion. So determine the Nyquist Rate for signal,  $g^3(t)$ , if  $g(t)=\cos 200\pi t$ .  
[2M] (C.O.No.1) [Knowledge Level]
4. A bandpass signal is a signal containing a band of frequencies not adjacent to zero frequency. If the bandwidth of a bandpass signal is given by 1600hz. The bandwidth of the inphase component of the signal is \_\_\_\_\_.  
[2M] (C.O.No.1) [Knowledge Level]
5. Nyquist Interval is the maximum time interval between equally spaced samples of a signal that will enable the signal waveform to be completely determined. So determine the Nyquist Interval for signal,  $g(t)=\text{sinc}(100t)$ . [2M] (C.O.No.1) [Knowledge Level]

**Part B [Thought Provoking Questions]**

**Answer all the Questions. Each question carries 10 marks. (1Qx10M=10M)**

6. Natural Sampling is a practical method of sampling in which pulse have finite width equal to “T”. Sampling is done in accordance with the carrier signal which is discrete in nature. With the help of functional diagram given below in fig.1 of a natural sampler, a sampled signal  $y(t)$  is obtained by multiplication of sampling function  $s(t)$  and the input signal  $g(t)$ , obtain the mathematical expression and also the spectrum of Natural Sampled Signal.  
[10M] (C.O.No.1) [Comprehensive Level]

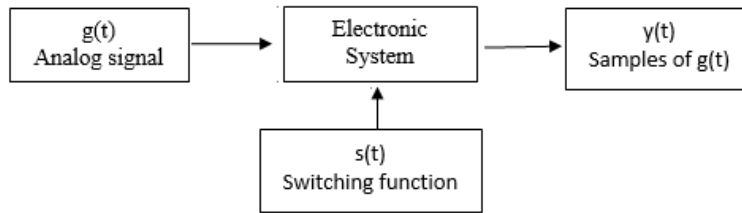


Fig.1: Function diagram of natural sampling

### Part C [Problem Solving Questions]

Answer all the Questions. Each question carries 5 marks.

(2Qx5M=10M)

7. When a communication link is shared by Time Division Multiplexing (TDM), time is divided into frames. Each frame is divided into time slots that are allocated in a fixed order to the different incoming channels. Consider the number of samples per frame is 6 and the frame rate is 200 frames/sec? If the width of each sample is  $30\mu\text{s}$  what is the time allocated for each channel and spacing between the two successive samples?

[5M] (C.O.No.1) [Comprehensive Level]

8. TDM is a communication process that transmit two or more digital signals over a common channel. Now consider 3 signals where signal  $m_1(t)$  is band limited to 1KHz,  $m_2(t)$  is band limited to 1KHz and  $m_3(t)$  is band limited to 2KHz. These signals are to be transmitted using TDM scheme. Determine

- (i) The speed of the commutator if each signal is sampled at its Nyquist rate
- (ii) Minimum transmission bandwidth?
- (iii) Give the commutator arrangement?
- (iv) Determine the total number of samples/sec?

[5M] (C.O.No.1) [Comprehensive Level]

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**PRESIDENCY UNIVERSITY BENGALURU**

**SCHOOL OF ENGINEERING**

**TEST-2**

**Even Semester:** 2021-22

**Course Code:** ECE 212

**Course Name:** Digital Communication

**Programme & Sem:** B.Tech & VI Sem

**Date:** 31<sup>st</sup> May 2022

**Time:** 01.30 PM to 02.30 PM

**Max Marks:** 30

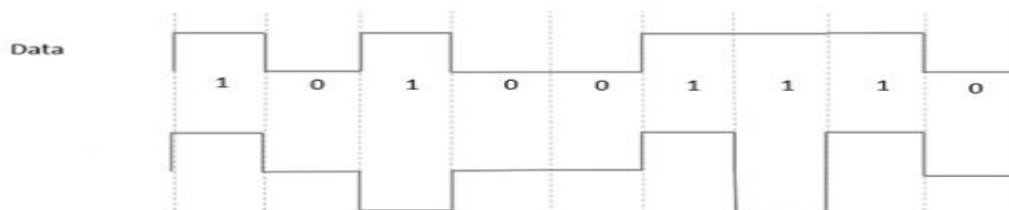
**Weightage:** 15%

**Part A [Memory Recall Questions]**

**Answer all Questions. Each question carries TEN mark.**

**(10QX1M=10M)**

- Speech signals are non-stationary in nature, means their statistical parameters like intensity and variance vary over time. The Speech signal has a frequency component range from \_\_\_\_\_ to \_\_\_\_\_ Hz. (C.O.NO.2) [B.Level: Knowledge]
- Companding is used to protect all small signals in PCM from quantizing noise. The standard value of  $\mu$  in  $\mu$ -law companding is \_\_\_\_\_. (C.O.NO.2) [B.Level: Knowledge]
- Given below is a sample data input and a signaling format. The signaling format used for the given data input is \_\_\_\_\_. (C.O.NO.3) [B.Level: Knowledge]



- Given data Input bit stream 1010011100. Use M-ary coding and represent the data with a neat waveform. (C.O.NO.3) [B.Level: Knowledge]
- Modulation techniques are roughly divided into four types: Analog modulation, Digital modulation, Pulse modulation, and Spread spectrum method. \_\_\_\_\_ Modulation technique uses past sample information to get the next encoded bit at output. (C.O.NO.2) [B.Level: Knowledge]
- A speech signal is sampled at 8 KHz and encoded in PCM format using 8 bit/Sample PCM data is transmitted through a baseband channel. Minimum bandwidth required for transmission is \_\_\_\_\_. (C.O.NO.2) [B.Level: Knowledge]
- SNR is defined as the ratio of signal power to the noise power, often expressed in decibels. The equation for SNR (db) in case of sinusoidal signal is \_\_\_\_\_.

(C.O.NO.2) [B.Level: Knowledge]

8. Quantization is the process of mapping continuous infinite values to a smaller set of discrete finite values. The other name for non-uniform quantization type where SNR is maintained constant throughout the signal range is \_\_\_\_\_ quantization.

(C.O.NO.2) [B.Level: Knowledge]

9. In acoustics and electronics, any change in a signal that alters the basic waveform or the relationship between various frequency components is called distortion. \_\_\_\_\_ is the type of distortion in DM where the signal has large dynamic range compared to small changes in step size.

(C.O.NO.2) [B.Level: Knowledge]

10. Identify and name the transfer characteristics of the non-uniform quantization.

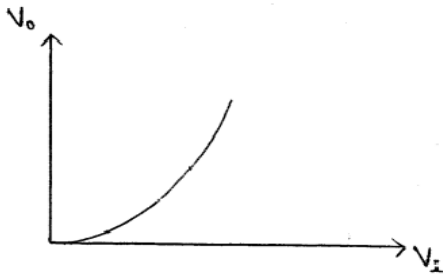


Fig a \_\_\_\_\_

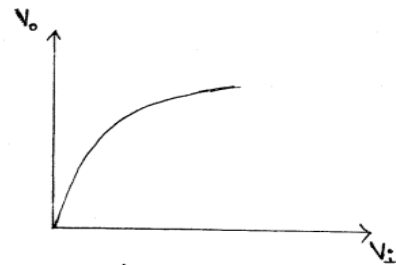


Fig b \_\_\_\_\_

(C.O.NO.2) [B.Level: Knowledge]

### Part B [Thought Provoking Questions]

Answer the Question. The question carries TEN marks.

(1Qx10M=10M)

11. In digital communication, the digital data is mirrored as variations in the amplitude of a carrier wave. Phase and frequency continue to be constant. Identify the Digital modulation technique and explain with neat diagrams, equations and signal space diagram for the same.

(C.O.NO 3) [B.level: Comprehension]

### Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries FIVE marks.

(2Qx5M=10M)

12. A PCM system which employs uniform quantization and produces a binary output, given an input signal whose amplitude varies from 6v to -6v having average power of 20mw. Calculate the number of bits/sample if the required SNR is 25db.

(C.O.NO 2) [B.level: Application]

13. If 4 bit PCM is used for speech signal ranging upto 3v calculate

- The resolution and quantization error
- Minimum Line speed
- Coding efficiency for a resolution of 0.3v

(C.O.NO 2) [B.level: Application]

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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF MANAGEMENT**

**END TERM EXAMINATION**

**Winter Semester:** 2021 - 22

**Course Code:** ECE 212

**Course Name:** DIGITAL COMMUNICATION

**Program & Sem:** B.Tech & VI Sem

**Date:** 28<sup>th</sup> June 2022

**Time:** 09:30 AM to 12:30 PM

**Max Marks:** 100

**Weightage:** 50%

**Instructions:**

*(iii) Read the all questions carefully and answer accordingly.*

*(iv) Scientific calculators are allowed; programmable calculators are not allowed.*

**Part A [Memory Recall Questions]**

**Answer all the Questions. Each question carries TWO marks.**

**(20Qx 2M= 40M)**

9. To convert a signal from continuous time to discrete time, a process called sampling is used. If the top of the samples remains constant and equal to the instantaneous value of the modulating signal at the start of the sampling is called \_\_\_\_\_ sampling and the sampling in which the top of sampled pulses retains their natural shape during the sampling interval is called \_\_\_\_\_ sampling. (C.O.No.1) [Knowledge Level]
10. Sampling is the process of measuring the instantaneous values of continuous-time signal in a discrete form. The sampling rate of  $2W$  samples per second for a signal bandwidth  $W$ Hz is called the \_\_\_\_\_ and  $1/2W$ sec is called the \_\_\_\_\_. (C.O.No.1) [Knowledge Level]
11. Nyquist Rate is the minimum sampling frequency needed to detect the original signal without distortion. So determine the Nyquist Rate for signal  $g^3(t)$ , if  $g(t)=\cos 200\pi t$ . (C.O.No.1) [Knowledge Level]
12. A bandpass signal is a signal containing a band of frequencies not adjacent to zero frequency. If the bandwidth of a bandpass signal is given by 1600hz. The bandwidth of the inphase component of the signal is \_\_\_\_\_. (C.O.No.1) [Knowledge Level]
13. Nyquist Interval is the maximum time interval between equally spaced samples of a signal that will enable the signal waveform to be completely determined. So determine the Nyquist Interval for signal,  $g(t)=\text{sinc}(100t)$ . (C.O.No.1) [Knowledge Level]



14. In Delta Modulation the present sample value is compared with the previous sample value and the difference is quantized. There fore \_\_\_\_\_ number of quantization levels and \_\_\_\_\_ number of bits/sample are required in DM. (C.O.No.2) [Knowledge Level]
15. The error observed when the slope of analog signal is much higher than the slope of the approximated staircase signal is \_\_\_\_\_ and the error observed when the step size is too large compared to small variations in the input signal is \_\_\_\_\_. (C.O.No.2) [Knowledge Level]
16. Bit rate represents the number of bits transmitted per second. In PCM the bit rate is \_\_\_\_\_ and in delta modulation the bit rate is \_\_\_\_\_. (C.O.No.2) [Knowledge Level]
17. The digital modulation technique that requires minimum bandwidth is \_\_\_\_\_. One-bit quantizer is used in \_\_\_\_\_ modulation. (C.O.No.2) [Knowledge Level]
18. Quantization noise is the effect of representing an analog continuous signal with a discrete number. Quantization noise can be reduced by \_\_\_\_\_ the number of levels. In PCM encoding, quantization level varies as a function of \_\_\_\_\_. (C.O.No.2) [Knowledge Level]
19. For the given binary sequence 100111010 draw the M-ary line code format; Assume M=4. (C.O.No.3) [Knowledge Level]
20. Draw the signal space diagram of QPSK. (C.O.No.3) [Knowledge Level]
21. The difference between coherent and non coherent modulation techniques lies in \_\_\_\_\_. (C.O.No.3) [Knowledge Level]
22. In BPSK \_\_\_\_\_ line code format is used to represent binary data stream; Justify your answer. (C.O.No.3) [Knowledge Level]
23. Digital data i.e binary digits are represented by different waveforms for the purpose of transmission over the channel. This process is called as \_\_\_\_\_ and also list any two of such techniques. (C.O.No.3) [Knowledge Level]
24. Spread Spectrum refers to a system originally developed for military applications, to provide secure communications by spreading the signal over a large frequency band. \_\_\_\_\_ is called as the bit duration of PN sequence and \_\_\_\_\_ is called as the rate of PN sequence. (C.O.No.4) [Knowledge Level]
25. Pseudo-Noise (PN) sequences are commonly used to generate noise that is approximately "white". It has applications in cryptography, and spread-spectrum communications. PN sequences are generated by \_\_\_\_\_ and the length of PN sequence is \_\_\_\_\_. (C.O.No.4) [Knowledge Level]
26. PN sequence is normally a sequence of bits. Multiplication of two same PN sequence is \_\_\_\_\_ and multiplication of two different PN sequence is \_\_\_\_\_. (C.O.No.4) [Knowledge Level]



27. Shift register is a series combination of flip-flops. \_\_\_\_\_ flip-flop is used to generate a PN sequence. How many flip-flops require to generate a PN sequence of length 7 bit.  
(C.O.No.4) [Knowledge Level]
28. A PN sequence is generated using a linear feedback shift register with number of stages equal to 10. The chip rate is  $10^7$  bits per second; then the length of PN sequence is \_\_\_\_\_ and Chip duration is \_\_\_\_\_.  
(C.O.No.4) [Knowledge Level]

### Part B [Thought Provoking Questions]

**Answer all the Questions. Each question carries TEN marks. (3Qx10M=30M)**

29. The over sampling of baseband signal is done to increase the correlation between adjacent samples of the signals. These highly correlated adjacent samples are then approximated by a quantizer which has only 2 quantization levels(1-bit quantizer). Identify the modulation scheme and explain it with neat diagrams, waveforms and relevant equations.  
(C.O.No.2) [Comprehension Level]
30. In a digital modulation, the bit rate can be increased by using multilevel modulation techniques. In 4-level modulation the data stream is divided into groups of 2bits and each group phase modulates the carrier by either  $\pi/4$ ,  $3\pi/4$ ,  $5\pi/4$ , or  $7\pi/4$  phase shift. Identify the modulation scheme and explain it with neat diagrams, waveforms and relevant equations.  
(C.O.No.3) [Comprehension Level]
31. A Satellite based navigation system uses DSSS as this gives a signal gain by spreading the signal out over a wide bandwidth. It also enables different satellites to use the same channel without mutual interference. Formulate the result at the output of a transmitter and receiver for a direct sequence spread spectrum if the binary message signal is given by  $b(t)$  and the pseudo noise signal is  $c(t)$  and also implement the appropriate modulation technique and construct the block diagrammatic representation of the technique.  
(C.O.No.4) [Comprehension Level]

### Part C [Problem Solving Questions]

**Answer all the Questions. Each question carries TEN marks. (3Qx10M=30M)**

32. Sampling is the process of converting CT signal to DT signal; The spectrum of signals  $g_1(t)$  and  $g_2(t)$  are shown in the below figure; Determine Nyquist sampling rate and Nyquist interval for the signals  $g_1(t)$ ,  $g_2(t)$ ,  $g_1^2(t)$ ,  $g_2^2(t)$ ,  $g_2^3(t)$ ,  $g_1(t)*g_2(t)$ .  
(C.O.No.1) [Comprehension Level]



33. Line codes are used for data transmission of a digital signal over a transmission line. For the given binary sequence 101011100; draw the line code formats corresponding to  
 i) Unipolar NRZ                      ii) Polar NRZ                      [10M] (C.O.No.3) [Comprehension Level]  
 iii) Polar RZ                              iv) Bipolar NRZ                      v) Manchester encoding
34. For the PN sequence generator shown in the figure below, obtain and draw the PN sequence.

Assume the initial state of the shift register is  $Q_3Q_2Q_1 = 001$ .

(C.O.No.4)[Comprehension Level]

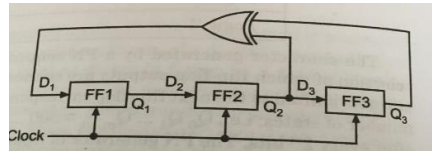


Figure: PN Sequence generator.