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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING  
MID TERM EXAMINATION - APR 2023**

**Semester :** Semester VI - 2020

**Course Code :** ECE3011

**Course Name :** Sem VI - ECE3011 - Digital Communication

**Program :** ECE

**Date :** 13-APR-2023

**Time :** 11:30AM - 1:00PM

**Max Marks :** 50

**Weightage :** 25%

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**Instructions:**

- (i) Read all questions carefully and answer accordingly.
  - (ii) Question paper consists of 3 parts.
  - (iii) Scientific and non-programmable calculator are permitted.
  - (iv) Do not write any information on the question paper other than Roll Number.
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**PART A**

**ANSWER ALL THE TEN QUESTIONS**

**10 X 2=20M**

1. As impulse train cannot be generated practically, ideal sampling method arises doubts among the telecommunication engineers. The main difference between ideal and practical sampling is  
a) the sampling rate is different (CO1) [Knowledge]  
b) the sampling pulses have small but finite pulse width  
c) the reconstruction filters are not required in practical sampling  
d) None of the above
2. Signal-to-noise ratio (SNR or S/N) is defined as the ratio of signal power to the noise power, often expressed in decibels. The SNR value with respect to quantization error in a PCM system depends on  
a) number of quantization levels (CO1) [Knowledge]  
b) signal bandwidth  
c) sampling rate  
d) carrier frequency
3. A bandpass signal is a signal containing a band of frequencies, whose lowest is not zero. Examples of such signal are that comes out of a bandpass filter. A continuous-time band pass signal has an upper frequency of 8 Hz and lower frequency of 4 Hz. It is sampled ideally at Nyquist rate by an impulse train for digital transmission. What would be the spacings between the samples in sec.  
a) 0.125 s (CO1) [Knowledge]  
b) 0.25 s  
c) 0.5 s  
d) 1 s

4. A triangular function is often used to approximate flat-top samples in time domain. Spectral or frequency estimation of triangular function is always necessary in signal processing applications. This is achieved by Fourier or Laplace transformation. What would be the Fourier transform result of a triangular signal.
- a) Sinc function (CO1) [Knowledge]  
 b) Rectangular function  
 c) Rectangular<sup>2</sup> function  
 d) Sinc<sup>2</sup> function
5. By applying Fourier transformation, we can identify the frequency spectrum of a signal or a system. The spectrum of an ideal low pass filter (LPF) after Fourier transform is found out to range between - 3 kHz to +3 kHz. What can be the bandwidth of this low pass filter (LPF).
- a) 6 kHz (CO1) [Knowledge]  
 b) 10 kHz  
 c) 3 kHz  
 d) 5 kHz
6. Sampling is the process of taking an analog signal and converting it to discrete numbers. The sampling frequency (or sampling rate) determines how many times per second the signal will be sampled. For a continuous-time signal generated after an experiment  $x(t) = 10 \cos(2000\pi t) \cos(1000\pi t)$  calculate the Nyquist rate.
- a) 3 kHz (CO2) [Knowledge]  
 b) 2 kHz  
 c) 1 kHz  
 d) Cannot be determined
7. While doing an experiment on radio broadcasting, a bandpass signal is generated that extends from 96 Hz -108 Hz. It is required to digitally transmit the signal, for which the signal is required to be sampled. Determine the minimum sampling frequency to avoid aliasing error.
- a) 20 Hz (CO2) [Knowledge]  
 b) 15 Hz  
 c) 14 Hz  
 d) 16 Hz
8. A digital communication system implemented by PCM method, transmits 4032 number of PCM voice signals. It is found that the bandwidth of each voice signal is 4 kHz. Also, it is measured that the bandwidth of the multiplexing system is 137 MHz. What can be the bandwidth efficiency of the multiplexing system.
- a) 12.33% (CO2) [Knowledge]  
 b) 10.11%  
 c) 13.55%  
 d) 11.77%
9. Quantization error plays an important role in determining the efficiency of a PCM system and it directly depends on the step size,  $\Delta$ . A good engineer would always try to keep the value of quantization error as low as possible. What can be maximum value of quantization error.
- a)  $\pm\Delta / 2$  (CO2) [Knowledge]  
 b)  $\pm\Delta^2$   
 c)  $2 / \Delta$   
 d) None of the above

10. Quantization is the process of mapping continuous infinite values to a smaller set of discrete finite values. In a PCM system, quantization plays a very important role in converting the amplitude of analog signal to finite digital values. Let the number of quantization levels and the number of bits per word in a PCM system is represented by  $L$  and  $n$  respectively. Then the relationship between  $L$  and  $n$  is
- a)  $L = \log n$  (CO2) [Knowledge]
  - b)  $L/n = \text{Const.}$
  - c)  $L = 2^n$
  - d)  $n = L^2$

### PART B

**ANSWER THE FOLLOWING QUESTION**

**1 X 10 = 10M**

11. Simultaneous transmission of RF signals without interference, still remains a challenge among the communication engineers for both analog and digital systems. Transmission of various analog signals simultaneously mainly employ Frequency Division Multiplexing (FDM), while in digital communications, Time Division Multiplexing (TDM) is used to simultaneously transmit several different digital signals over a single channel. With the help of a neat diagram, explain the scheme of TDM for  $N$  number of signals. Also, show the schematic of two discrete-time signals being time division multiplexed.
- (CO2) [Comprehension]

### PART C

**ANSWER ALL THE TWO QUESTIONS**

**2 X 10 = 20M**

12. Digital communication is the communication between the transmitter and receiver using various devices and methods, such as encoder, decoder, data compression, etc. The schematic of a basic digital communication system is made up of different blocks. Elucidate and draw the schematic diagram of a basic digital communication system and describe the purpose of the source encoder/decoder block.
- (CO1) [Application]
13. A sinc is an even function with unity area. A sinc pulse passes through zero at all positive and negative integers (i.e.,  $t = \pm 1, \pm 2, \dots$ ), but at time  $t = 0$ , it reaches its peak value. It is a mathematical function that describes the frequency response of an ideal low-pass filter. It is used in signal processing to model the reconstruction of a continuous-time signal from a sampled signal. Find the Nyquist rate of the function  $\text{sinc}^2 [200t]$ .
- (CO2) [Application]