PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - OCT 2023

Semester : Semester V - 2021

Course Code : ECE3011

Course Name : Sem V - ECE3011 - Digital Communication

Program : B. TECH

Date : 2-NOV-2023

Time : 9:30AM - 11:00AM

Max Marks : 50

Weightage : 25%

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.

PART A

ANSWER ALL THE QUESTIONS   (5 X 2 = 10M)

1. A bandpass signal is a signal containing a band of frequencis, whose lowest frequency is not zero. Examples of such signal are that comes out of a bandpass filter. A continuous-time bandpass signal has an upper frequency of 8 kHz and lower frequency of 4 kHz. It is sampled ideally at Nyquist rate by an impulse train, for digital signal transmission. What could be the spacings between the samples, in sec.

                                                                (CO1) [Knowledge]

2. A multi-frequency continuous-time analog low pass signal is required to be converted to discrete-time signal for possible digital transmission of the samples over the horizon.
   The expression of the low pass signal is given by the equation *x(t) = -8Cos1000πt-8.3Cos1200πt+Sin950πt-11Sin1300πt*. Determine the minimum sampling frequency of *x(t)*.

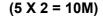   (CO1) [Knowledge]

3. Sinusoids are the simplest and considered as the basic component of a more complex or multi-frequency signal. To understand the property and characteristics of a multi-frequency signals, engineers try to find out the number and types of sinusoids composed in that signal. A sinusoidal signal is given as *x(t) = 5Cos500πt.* Determine the minimum sampling frequency of the signal $x^2(t)$, assuming low pass signal sampling concept.

                                                                (CO1) [Knowledge]

4. Quantization error plays an important role in determining the efficiency of a PCM system and it directly depends on the step size $\triangle$. A good engineer would always try to keep the value of quantization error as low as possible. What can be the maximum value of quantization error in terms of $\triangle$.

                                                                (CO2) [Knowledge]

5. Regenerative repeaters play a significant role in modrern digital communication systems in transmission of high frequency signal over a long distance. Regenerative repeaters are installed at regular intervals in wireless channel environment where digital transmission is intended using PCM system. These aids in pulse reshaping and reducing electrical noise somewhat, that have been acquired during signal propagation. Draw a simple block diagram representation of a regenerative repeater, used in a PCM system.

(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS   (2 X 10 = 20M)

6. Digital communication is the conveying of information 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) [Comprehension]

7. The process of transforming sampled amplitude values of a message signal into a discrete amplitude values (levels) is known as quantization. Quantization approximates each of input sample values to a nearest prefixed level. Although, non-uniform quantization method is exclusively used nowadays, uniform quantization with fixed level size, still finds applications for uniform amplitude signal transmissions. What are the types of uniform quantization methods that are used in PCM ? Explain briefly the types of uniform quantization methods with neat diagrams.

(CO2) [Comprehension]

PART C

ANSWER THE FOLLOWING QUESTION   (1 X 20 = 20M)

8. Almost all electrical signals that are available in nature, and/or generated in laboratories are time-limited in characteristics. That is, the signals exist for a finite duration of time. Although, this seems quiet obvious, but time-limited signals pose a huge problem in physics and engineering, as in frequency domain, they possess band-unlimited characteristic (i.e., infinite frequency). No circuits or systems can be developed that can track or measure infinite values of amplitude or frquencies. Fortunately, amplitudes of the higher frequency components decay drastically and becomes considerably negligible, we can comfortably ignore them. A gate function is a very common rectangular pulse, which is a time-limited signal. (a) A gate function is given as : $x(t) = A \prod (t/\tau)$. Sketch the waveform. (b) Find the frequency components of x (t), by Fourier transformation. (c) Sketch the Fourier transformed pair X(w) or X(f). (d) Find the value of highest frequency or BW upto the first null of amplitude value. (e) Determine the Nyquist sampling frequency.

(CO2) [Application]