PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023

Semester : Semester VI - 2020　　　　　　　　　**Date :** 12-JUN-2023
Course Code : ECE3011　　　　　　　　　　　　**Time :** 9.30AM - 12.30PM
Course Name : Sem VI - ECE3011 - Digital Communication　**Max Marks :** 100
Program : ECE　　　　　　　　　　　　　　　　　**Weightage :** 50%

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　　　　　　　　　**(15 X 2 = 30M)**

1. By the advent of spread spectrum techniques in digital communication, efficient transmission of signals in a hostile, highly distorted, multipath channel has become possible with even negative values of signal-to-noise ratio (SNR) in dB. Name the modulation techniques that are used in spread spectrum.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(CO5) [Knowledge]

2. A compact disc (CD) records audio signal digitally by Pulse Code Modulation (PCM) technique. Assume audio signal's bandwidth to be 15 kHz. If signals are sampled at a rate 20% above Nyquist rate for practical reasons and the samples are quantized into 65,536 levels, determine bits/sec. required to encode the signal.

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3. The bandwidth of a video signal is 4.5 MHz. This signal is to be transmitted using PCM with the number of quantization levels L = 1024. The sampling rate used is same as that of the Nyquist rate. Calculate the system bit rate.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(CO1) [Knowledge]

4. Differential Pulse Code Modulation (DPCM) method overcomes the disadvantages of PCM and evables more efficient digital transmission of data. Enumerate atleast two advantages of DPCM over PCM in modern digital communication systems.

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5. In sampling process, if Nyquist criteria is not maintained, i.e., if the analog signal is sampled at a rate lower than the Nyquist rate, then distortions occur at the time of signal reconstruction. This distortion is known as aliasing. Explain the phenomenon of aliasing.

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6. In all digital modulation techniques, the use of digital-to-analog converters are inevitable in the demodulation circuits. In a certain digital-to-analog converter, the step size used is 0.25 V and the full-scale output is 8 V. Determine the number of input binary bits.

(CO4) [Knowledge]

7. Spread Spectrum concept has opened a new opportunity in digital communication for more efficient transmission of signals in a noisy environment. Both military and civilian uses benefit from spread spectrum systems. State the salient advantages and disadvantages of using a spread spectrum system.

(CO5) [Knowledge]

8. In terms of detection of signals, the digital demodulators can be either coherent or non-coherent in nature. Explain two differences between coherent and non-coherent detection.

(CO2) [Knowledge]

9. Quantization method drastically reduces the transmission bandwidth of a Pulse Code Modulation technique. Explain briefly how a uniform quantizer is different from a non-uniform quantizer.

(CO3) [Knowledge]

10. Amplitude Shift Keying (ASK) and Frequency Shift Keying (FSK) are the extensively used in digital carrier modulation in almost all modern communication engineering processes. Sketch the differences between these to modulation methods with suitable waveform diagrams.

(CO4) [Knowledge]

11. An analog signal of bandwidth 625 Hz is transmitted by a multilevel digital communication transmitter based on PCM-TDM (Pulse Code Modulation-Time Division Multiplexing) of 16 quantization levels. The samples are obtained by Nyquist rate. Determine the bit rate of the syatem.

(CO2) [Knowledge]

12. An analog signal of certain bandwidth is transmitted digitally. The analog to digital conversion is accomplished by using a binary Pulse Code Modulation (PCM) system, The number of quantization levels used are 512. Determine the length of the bit stream.

(CO4) [Knowledge]

13. Digital transmission of analog signals is possible by the virtue of sampling theorem, and the sampling operation is performed in accordance with the sampling theorem. State the Nyquist sampling theorem for low pass signals with appropriate mathematical expressions.

(CO1) [Knowledge]

14. Application of sampling theorem by Nyquist is one of the major step in any digital modulation techniques in modern day digital transmission of data. A passband analog signal x(t) is available for digital communication with the highest frequency of 2 kHz. Find the Nyquist sampling rate of the signal x(2t).

(CO3) [Knowledge]

15. Frequency Hopping Spread Spectrum (FHSS) and Direct Sequence Spread Spectrum (DSSS) are the two important techniques of spread spectrum communication which enables high efficiency and elegent methods to avoid interferences. Briefly explain the Frequency Hopping Spread Spectrum (FHSS) in modern digital communication perspective.

(CO5) [Knowledge]

16. In the case of non-uniform quantization, noise can be made proportional to the signal size. The effect is to improve the signal-to-noise (quantization) ratio (SNR) by reducing the noise for the predominant weak signals at the expense of an increase in noise for the rarely occurring strong signals. Non-uniform quantization can be achieved by the method of cpmpanding. (a) Explain the method of companding by compressor and expander characteristics. (b) State the advantages and disadvantages of PCM. (c) A PCM system uses a uniform quantizer followed by a 7 bit encoder. The system bit rate is 50 Mbps. Calculate the maximum bandwidth of the message signal for which this system operates satisfactorily.

(CO4) [Comprehension]

17. The delta modulation (DM), often denoted as $\triangle$ modulator, is a process that embeds a low resolution A-to-D converter in a sampled data feedback loop that operates at rates far in excess of the signal's required Nyquist rate. The motivation for using DM technique is our awareness that in the conversion process, speed is less expensive than precision and that one can use faster signal processing to obtain higher orecision. (a) Explain the working of a DM system with block diagrams of transmitter and receiver. (b) In a DM scheme, a voice signal is sampled at a rate of 64 kHz. The maximum signal amplitude is 1 Volt. Determine the minimum value of step size to avoid slope overload. (c) State the advantages and disadvantages of delta modulation.

(CO2) [Comprehension]

PART C

18. The multiple access techniques that were used once upon a time worldwide, were Frequency Division Multiple Access (FDMA) for analog modulation and Time Division Multiple Access (TDMA) for digital modulation. But these access methods suffer from serious disadvantages of interference, irrespective of guard bands. By the advent of CDMA (Code Division Multiple Access) in 2.5 G of mobile telephony, the problem of interference from subsequent channels have been drastically lowered down. List the characteristics of CDMA that uses direct sequence spread spectrum signals.

(CO5) [Application]

19. Pulse Code Modulation (PCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM) and Differential Pulse Code Modulation (DPCM) are the digital modulation methods that are extensively used for conversion of analog signal to digital or binary counterparts. Give a comparison table of performance among these four methods in terms of transmission bandwidth, quantization error, number of transmission bits per sample, etc.

(CO3) [Application]