Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

SUBJECT: ECE1-518/ DIGITAL COMMUNICATION SYSTEM

SEM / YEAR : V / III

UNIT - I

SAMPLING AND QUANTIZATION

Part A

1. State sampling theorem for low passsignals..
2. Compare uniform and non-uniformquantization.
3. Why is pre-filtering done before sampling?
4. What is natural sampling and flat-topsampling?
5. List out the components required for signal reconstruction
6. Define the term aliasing.
7. Compare DM and PCM.
8. What is meant by quantization?
9. What is the need for non-uniformquantization?
10. State any two non-uniform quantization rules.
11. Define quantization noise power.
12. Define Nyquist rate and Nyquist interval.
13. A signal is sampled at Nyquist rate of 8 KHz and is quantized using 8 bit uniform quantizer. Assuming SNR for a sinusoidal signal, calculate the bit rate, SNR and BW.
14. What is Companding?
15. Write μ-law of compression.
16. What is TDM?
17. Draw the block diagram of TDM.
18. What is the need for synchronization in TDM?
19. Define PAM
20. Write the advantages and disadvantages of TDM.

PART-B

1. State the sampling theorem. Explain the ideal sampling process with necessary expressions and diagrams. (10)
2. Explain
   (i) Natural Sampling and Flat-top Sampling (10)
   (ii) Sample and Hold circuit. (5)
3. The signal $g(t) = 10\cos(20\pi t)\cos(200\pi t)$ is sampled at the rate of 250 samples per second.
   (a) Determine the spectrum of the resulting sampled signal.
   (b) Specify the cut-off frequency of the ideal reconstruction filter so as to recover g(t) from its sampled version.
   (c) What is the Nyquist rate for g(t).
   (d) Explain the reconstruction process of a message from its samples. (10)
4. Explain the process of quantization and obtain an expression for signal to Quantization ratio in the case of a uniform quantizer. (10)
5. Explain the characteristics of Non-uniform quantization with diagrams. Also compare uniform and non-uniform quantization methods. (10)
6. Briefly discuss about quadrature sampling of band-pass signals. Derive the expression for SDR. (10)
7. Write short notes on
   (i) Analog companding and (5)
   (ii) (ii) Digital companding. (5)
8. With neat diagrams, Pulse Code Modulation and demodulationsystem.(10)
9. A compact disc (CD) records audio signals digitally using PCM. Assume the audio signal bandwidth to be 15 KHz.
   (a) What is the Nyquist rate?
   (b) If the Nyquist samples are quantized to L = 65, 536 levels and then binary coded, determine the number of bits required to encode a sample.
   (c) Assuming that the signal is sinusoidal and that the maximum signal amplitude is 1 volt; determine the quantization step and the signal-to-quantization noise ratio.
   (d) Determine the number of bits per second (bit/s) required to encode the audio signal.
   (e) For practical reasons, signals are sampled at above the Nyquist rate, as discussed in class. Practical CDs use 44,000 samples per second. For L = 65, 536 determine the number of bits per second required to encode the signal and the minimum bandwidth required to transmit the encoded signal.
10. What is PAM? Explain TDM process with necessary diagrams. (10)

UNIT - II

WAVEFORM CODING

Part A

1. Define prediction error.
2. State the 2 properties of linear prediction.
3. Differentiate PCM and DPCM.
4. What is prediction gain? State its significance.
5. What is delta modulation?
6. Mention the drawbacks of DM.
7. A speech signal with maximum frequency of 3.4 KHz and maximum amplitude of 1 V. this speech signal is applied to a delta modulator whose bit rate is set at 20 Kbps. Discuss the choice of an appropriate step size for the delta modulator.
8. The idle channel noise in a delta modulator is negligibly small. Justify the validity of this statement.
9. What is slope overload and granular noise?
10. State the principle of ADM.
11. Compare DM and ADM.
12. What are the objectives of speech coding?
13. Define ADPCM.
14. What are the different types of adaptive quantization?
15. Define APF.
16. Define APB.
17. What is the principle of linear predictive coder (LPC)?
18. Draw the model of LPC.
19. Mention the applications of LPC.
20. What is adaptive sub-band coding?

Part B

1) What is DM? Explain the transmitter and receiver of DM system. (10)
2) Explain a DPCM systemwith the expressions and block diagram. Show that SNR of DPCM is better than that of PCM. (10)
3) Explain the noises in delta modulation systems. How to overcome this effect in Delta modulation? (10)
4) Describe temporal and spectral waveform encoding methods. (10)
5) With necessary diagrams, explain ADPCM system. (10)
6) Write short notes on
   (i) Adaptive quantization schemes
   (ii) Adaptive prediction schemes.
7) What is low bit rate speech coding? Draw the block diagram of adaptive sub-band coding scheme for speech signal and explain. (10)
8) Discuss about the structure of linear predictor. Also explain the process of prediction error. (10)
9) Explain the principle of LPC model with diagrams. (10)
10) Compare the various types of speech encoding techniques. (10)

UNIT - III

BASEBAND TRANSMISSION

Part – A

1. What is line coding?
2. Define transparency of a line code. Give two examples of line codes which are not transparent.
3. State any 4 properties of a line code.
4. What is Manchester code? Draw its format for the data 10011.
5. Draw the RZ-Bipolar line code for the data 110100.
6. Draw the NRZ and RZ code for the digital data 10110001.
7. What are the requirements of a line code?
8. What is ISI?
9. 'ISI can-not be avoided'. Justify the statement.
10. How does pulse shaping reduce ISI?
11. Draw the ideal and basic amplitude response of pulse waveforms.
12. Define roll-off factor.
13. State the Nyquist criterion for zero ISI.
14. What is Eye pattern? State any 2 applications of eye pattern..
15. What is equalization?
16. What is correlative coding?
17. Define duo binary system. What are the drawbacks of it?
18. Draw the block diagram of adaptive equalizer.
19. What are the methods used to implement adaptive equalizer?
20. Why do we need equalization filter?

Part B

1) Derive the power spectral density of polar RZ codeand explain. (10)
2) Derive the expression for power spectral density of unipolar NRZ line code. Hence discuss its characteristics. (10)
3) (i) List and explain the properties of line codes. (5)

   (ii) Derive the power spectral density of Manchester code. (5)
4) Explain modified duo-binary signaling scheme with & without procedure. (10)
5) Explain how ISI occurs in base-band binary datatransmission system. (10)
6) Describe the Nyquist criterion method for distortion less transmission. (10)
7) The Fourier transform P(f) of the basis pulse p(t) employed in a certain binary communication system is given by

$$P(f) = \begin{cases} 10^{-6}\left(1 - \frac{|f|}{10^{6}}\right) & if\ 10^{-6} \le f(Hz) \le 10^{6} \\ 0 & Otherwise \end{cases}$$

   (a) From the shape of P(f), explain whether this pulse satisfies the Nyquist criterion for ISI free transmission.
   (b) Determine p(t) and verify your result in part a.
   (c) If the pulse does satisfy the Nyquist criterion. What is the transmission rate (in bits/sec.) and what is the roll-off factor?

8) Explain the pulse shaping method to minimize ISI. (10)
9) Draw and explain the block diagram of duo-binary signaling scheme for controlled ISI. (10)
10) Briefly discuss about
   (i) Eye pattern. (5)
   (ii) Adaptive equalization. (5)

Unit - IV

DIGITAL MODULATION SCHEME

Part A

1. What is the need for geometric representation of signals?
2. Why we go for Gram- Schmidt orthogonalization procedure?
3. Define BPSK and DPSK.
4. Why is PSK always preferable over ASK in Coherent detection?
5. What are the drawbacks of binary PSK system?
6. A BFSK system employs two signaling frequencies f_1 and f_2. The lower frequency f_1 is 1200 Hz and signaling rate is 500 Baud. Calculate f_2.
7. What are the advantages of QPSK over PSK?
8. What is constellation diagram?
9. A BPSK system makes errors at the average rate of 100 errors per day. Data rate is 1 Kbps. The single-sided noise power spectral density is 10 W/Hz. Assume the system to be wide sense stationary, what is the average biterror probability?
10. Define QAM and draw its constellation diagram for M=8.
11. Write the special features of QAM.
12. Differentiate coherent and non-coherent detection.
13. Define spectral efficiency.
14. What is meant by symbol synchronization?
15. List out the difference between carrier recovery and clockrecovery.
16. Compare the error probability for BPSK and QPSK.
17. What is the error probability of DPSK?
18. Write the features of DPSK.
19. What is meant by memoryless modulation?
20. Compare BER and SER

Part B

1. Describe with diagrams the generation and detection of coherent BFSK. Explain the probability of error for this scheme. (10)

2. Explain non coherent detection methods of binary frequency shift keying scheme. (10)

3. Explain the generation and detection of binary PSK. Also derive the probability of error for PSK. (10)

4. Compare the performance of various coherent and non-coherent digital detection systems. (10)

5. Discuss about coherent detection of QPSK and derive its power spectral density. (10)

6. With constellation diagram, explain the QAM transmitter. Also derive its power spectral density. (10)

7. A set of binary data is sent at the rate of R_b = 100 Kbps over a channel with 60 dB transmission loss and power spectral density $\eta\eta$ = 10^{-12} W/Hz at the receiver. Determine the transmitted power for a bit error probability $P_e = 10^{-3}$ for the following modulation schemes.
   (i) FSK (iii) PSK
   (ii) DPSK (iv) 16 QAM

8. Explain the carrier synchronization methods with block diagrams. (10)

9. Briefly discuss about the Non-coherent detection of PSK and QPSK. (10)

10. Briefly discuss about the principle of DPSK system. (10)

UNIT- V

ERROR CONTROL CODING

Part A

1. State the channel coding theorem.
2. What are the objectives of channel coding?
3. Define coding efficiency.
4. Define Hamming distance and calculate its value for two code words 11100 and 11011.
5. Define Hamming weight and minimumdistance.
6. State the significance of minimum distance of a block code.
7. State the principle of error free communication.
8. Define linear block codes.
9. Write syndrome properties of linear block codes.
10. What is Hamming codes?
11. Write the advantages and disadvantages of Hammingcodes.
12. Define syndrome vector.
13. Mention the properties of cyclic code.
14. State any 2 properties of generator polynomial.
15. What are the advantages and disadvantages of cyclic code?
16. What is convolutional code? How is it different from block codes?
17. Mention the structural properties of a convolutional encoder.
18. What is meant by BCH code?
19. Define CRC codes.
20. What is Viterbi decoding scheme?

Part B

1. Construct a single error correcting (7, 4) linear block code and the corresponding decoding table. (10)
2. (i) Explain the generation of (n, k) blocks codes and how block codes can be used for error control. (10)
   (ii) Explain the syndrome decoder for cyclic codes. (5)
3. Consider a (7, 4) linear block code whose parity check matrix is given by

$$H = \begin{matrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{matrix}$$

   (i) Find the generator matrix.
   (ii) How many errors this code candetect?
   (iii) How many errors can this code becorrected?
   (iv) Draw circuit for encoder and syndrome computation. (10)
4. The generator polynomial of a (7, 4) Hamming code is defined by
   $g(D) = 1 + D^2 + D^3$
   Develop the encoder and syndrome calculator for this code. (10)
5. (i) Find a generator polynomial for a (7, 4) cyclic code and hence find the code word for [1 1 0 0]. (5)
   (ii) Construct the encoder for (7, 4) cyclic codes. (5)
6. Explain how encoding is done by convolutional codes with an example. (10)
7. For (6, 3) systematic linear block code, the code word comprises I_1, I_2, I_3 and P_1, P_2, P_3 where the three parity check bits are formed from the information bits as follows:
   $P_1 = I_1 \quad I_2$
   $P_2 = I_1 \quad I_3$
   $P_3 = I_2 \quad I_3$

   Find: (i) Parity check matrix and generator matrix (2)
   (ii) All possible code words. (2)
   (iii) Minimum weight and minimum distance. (2)
   (iv) Error detecting and correcting capability of the code. (2)
   (v) If the received sequence is 101010, calculate the syndrome and decode the received sequence. (5)
8. Describe the steps involved in the generation of linear block codes. Define and explain properties of syndrome. (10)
9. Explain Viterbi algorithm to decode a convolutionally coded message.(10)
10. Design a convolutional coder of constraint length 6 and rate efficiency 1/2. Draw its tree diagram and trellis diagram. (10

BABA BANDA SINGH BAHADUR ENGINEERING COLLEGE
FATEHGARH SAHIB

Subject: Digital Communication System **Semester**-5th
Subject code: BECE1-518 **Examinar**:Dr.Raju Sharma

Question Bank

This set of Digital Communications Multiple Choice Questions & Answers (MCQs) focuses on "Digital communication".

1. Digital communication is_____to environmental changes?
a) Less sensitive
b) More sensitive
c) Does not depend
d) None of the mentioned

2. Advantages of digital communication are
a) Easy multiplexing
b) Easy processing
c) Reliable
d) All of the mentioned

3. What is necessary for digital communication?
a) Precision timing
b) Frame synchronization
c) Character synchronization
d) All of the mentioned

4. What are the disadvantages of digital communication?
a) Needs more bandwidth
b) Is more complex
c) Needs more bandwidth & Is more complex
d) None of the mentioned

5. Examples of digital communication are
a) ISDN
b) Modems

c) Classical telephony
d) All of the mentioned

6. Which system uses digital transmission?
a) ISDN
b) LANs
c) ISDN & LANs
d) None of the mentioned

7. The interval of frequencies outside which the spectrum is zero is called as _____
a) null to null bandwidth
b) normalized bandwidth
c) absolute bandwidth
d) none of the mentioned

8. The attenuation level in bounded power spectral density is
a) 35
b) 50
c) 35 & 50
d) none of the mentioned

9. Synchronization available in digital communication are
a) Symbol synchronization
b) Frame synchronization
c) Carrier synchronization
d) All of the mentioned

10. Digital system includes
a) Better encryption algorithm
b) Difficult data multiplexing
c) All of the mentioned
d) None of the mentioned

11. What are the main features of a receiver?
a) Synchronization

b) Multiple parallel receiver chain
c) Synchronization & Multiple parallel receiver chain
d) None of the mentioned

12. What conditions must be fulfilled in a good digital communication system?
a) High data rate
b) High fidelity
c) Low transmit power
d) All of the mentioned

13. Wired channels are
a1) Lossy
b) Lossless
c) Lossy & Lossless
d) None of the mentioned

14. The equivalent temperature in a receiver design must be kept
a) Low
b) High
c) Does not affect the receiver
d) None of the mentioned

15. Which corrects the sampling time problem in a digital system?
a) Interpolator
b) Decimator
c) Equalizer
d) Filter

16. What are the main features of a transmitter?
a) Higher clock speed
b) Linear power amplifier
c) Directional antennas
d) All of the mentioned

17. Transmission media used in low frequency band are
a) Air

b) Water
c) Copper cable
d) All of the mentioned

18. Transmission media used for medium frequency band are
a) Coaxial cable
b) Copper cable
c) Optical fiber
d) All of the mentioned

19. Matched filter technique is used to
a) Increase SNR
b) Decrease SNR
c) SNR is not affected
d) None of the mentioned

20. Matched filter can also be used as least squares estimator.
a) True
b) False

21. Digital communication system can handle
a) Analog signals
b) 1D signals
c) 2D signals
d) All of the mentioned

22. The information source of a digital communication system can be
a) Packetized
b) Continuous
c) Packetized & Continuous
d) None of the mentioned

Set -2

1. Which are the common transmission media used in digital communication system?

a) Coaxial cable

b) Twisted copper cable

c) Radio frequency bands

d) All of the mentioned

2. The basic transmission-reception system is a_____system.

a) Two block system

b) Three block system

c) Four block system

d) None of the mentioned

3. Modulation channel consists of

a) Amplifier

b) Signal processing units

c) Amplifier & Signal processing units

d) None of the mentioned

4. Modulation channel does not accept an analog input signal.

a) True

b) False

5. If operating frequency bands are higher_____is available.

a) Smaller bandwidth

b) Larger bandwidth

c) Smaller & Larger bandwidth

d) Cannot be determined

6. Ground wave communication occura) Low frequency band
b) Medium frequency band
c) Low & Medium frequency band
d) None of the mentioned

7. Sampling theorem is used for converting
a) Continuous time signal to discrete
b) Discrete to continuous time signal
c) Continuous time signal to discrete & vice versa
d) None of the mentioned

8. A signal can be recovered from its sample by using
a) Low pass filter
b) High pass filter
c) Band pass filter
d) Band stop filter

9. Which is practically realizable?
a) A train of pulses
b) Impulse train
c) All of the mentioned
d) None of the mentioned

10. In flat top sampling scheme,_____is kept constant after sampling.
a) Amplitude
b) Phase
c) Frequency
d) Time period

11. Loop filter is a_____used to reduce noise.
a) Low pass filter
b) High pass filter
c) Band pass filter
d) Band reject filter

11. A stationary stochastic process has
a) Finite energy signal
b) Infinite zero signal

c) Zero energy signal
d) None of the mentioned

12. The power spectral density function of the stochastic process is
a) Real
b) Odd
c) Real & odd
d) None of the mentioned

13. For a periodic function, the spectral density and auto correlation functions form
a) Fourier transform pair
b) Laplace transform pair
c) Hilbert transform pair
d) Z transform pair

14. The capacity of a channel is given by
a) Number of digits used in coding
b) Volume of information it can take
c) Maximum rate of information transmitted
d) Bandwidth requires information

15. In a communication system, a process in which statistical averages and time averages are equal is called as
a) Stationary
b) Ergodic
c) Gaussian
d) Poisson

16. A rectangular pulse of duration T is applied to a matched filter. The output of the filter is a
a) Rectangular pulse of duration T
b) Rectangular pulse of duration 2T
c) Triangular pulse
d) Sine function

17. The line code has a zero dc component for pulse transmission of random binary data is

a) NRZ

b) RZ

c) Alternate mark inversion

d) None of the mentioned

18. The auto-correlation of white noise is

a) A delta function

b) A constant

c) Gaussian

d) None of the mentioned

19. Ionospheric communication can take place in

a) High frequency band

b) Very high frequency band

c) Ultra high frequency band

d) Super high frequency band

20. Satellite communication takes place in

a) Ultra high frequency band

b) Super high frequency band

c) Ultra & Super high frequency band

d) None of the mentioned

21. The weighing matrix is

a) Positive quantity

b) Inverse of covariance matrix of the input vector

c) Positive quantity & Inverse of a covariance matrix of the input vector

d) None of the mentioned

22. Non uniform tree_____bit rate.

a) Increases

b) Decreases

c) Does not affect

d) None of the mentioned

SET-3

1. In the digital communication system, signals in different frequency bands are
a) Orthogonal
b) Non orthogonal
c) Orthogonal & Non orthogonal
d) None of the mentioned

2. Properties of impulse function are
a) Symmetry
b) Time scaling
c) Shifting
d) All of the mentioned

3. Properties of Fourier transform are
a) Duality property
b) Time shifting property
c) Modulation property
d) All of the mentioned

4. A base-band signal can be up-converted using
a) Sine wave
b) Cosine wave
c) Filtering
d) None of the mentioned

5. A band-pass signal can be down-converted using
a) Sine wave
b) Cosine wave
c) Time delayed wave
d) None of the mentioned

6. In down-conversion multiplication with cosine wave is followed by

a) Low pass filter

b) High pass filter

c) Bandpass filter

d) Bandstop filter

7. ADSL has_____information channels.

a) One

b) Three

c) Four

d) None of the mentioned

8. Fourier transform of a signal gives the

a) Frequency content

b) Bandwidth

c) Frequency content & Bandwidth

d) None of the mentioned

9. Random things in a communication system are

a) Timing offset

b) Device frequency

c) Attenuation

d) All of the mentioned

10. Which can be used for periodic and non periodic?

a) Fourier series

b) Fourier transforms

c) Fourier series & transforms

d) None of the mentioned

11. A band-pass signal has a Fourier transform equal to

a) One

b) Zero

c) Infinity

d) Cannot be determined

12. A band-pass signal has

a) DC component

b) No DC component

c) No side lobes

d) Cannot be determined

13. Which are orthonormal signal representation?

a) Sine and cosine at same frequency

b) Wavelets

c) Complex sinusoids at a different frequency

d) All of the mentioned

14. Constellation diagram is plotted in

a) Constellation space

b) Signal space

c) Orthogonal space

d) Boundary space

15. Cumulative distributive function is

a) Non negative

b) Non decreasing

c) Non negative & decreasing

d) None of the mentioned

16. Which are non negative functions?

a) PDF

b) PMF

c) PDF & PMF

d) None of the mentioned

17. The sampling process includes methods such as

a) Filtering

b) Sample and hold

c) Amplifying

d) None of the mentioned

18. The output of sampling process are called as _____

a) Pulse code modulation

b) Pulse amplitude modulation

c) Frequency modulation

d) Amplitude modulation

19. According to Sampling theorem

a) Ts is greater than 1/2fm

b) Ts is lesser than 1/2fm

c) Ts is equal to 1/2fm

d) Ts is lesser than or equal to 1/2fm

20. The fourier tranform of one impulse train is also another impulse train with a period of the output equal to the

a) Period of the input

b) Reciprocal of the period of input signal

c) Half the period of input

d) Twice the period of the input

21. The process in which the top of each pulse in the output samples retains the shape of the analog segment is called as _____

a) Natural sampling

b) Ideal sampling

c) Aliasing

d) None of the mentioned

22. The effects of aliasing are _____

a) Attenuation of high frequency spectral replicates

b) Non uniform spectral gain applied to desired baseband spectrum

c) Attenuation and non uniform spectral gain

d) None of the mentioned

23. Aliasing can be removed using

a) Prefiltering

b) Postfiltering

c) Prefiltering & Postfiltering

d) None of the mentioned

24. Which process is more economical?

a) Undersampling

b) Oversampling

c) Aliasing

d) None of the mentioned

25. Flat top sampling or practical sampling has

a) Same frequency

b) Same amplitude

c) Same time difference

d) None of the mentioned

26.. Multiplication of input signal with pulse train is done in_____sampling.

a) Impulse sampling

b) Natural sampling

c) Flat top sampling
d) None of the mentioned

SET-4

This set of Digital Communications Multiple Choice Questions & Answers (MCQs) focuses on "Sources of corruption".

1. The main sources of corruption are
a) Sampling and quantizing effects
b) Channel effects
c) Sampling, quantizing and channel effects
d) None of the mentioned

2. The distortion in quantization is called as
a) Round off error
b) Truncation error
c) Round off & Truncation error
d) None of the mentioned

3. In quantization process, the amount of quantization noise is_____to number of levels.
a) Directly proportional
b) Inversely proportional
c) Independent
d) None of the mentioned

4. Saturation noises can be avoided or reduced by
a) Automatic gain control
b) Amplifying
c) Filtering
d) None of the mentioned

5. Timing jitter can be reduced by

a) Good power supply isolation

b) Stable clock reference

c) Good power supply isolation & Stable clock reference

d) None of the mentioned

6. The reasons for the threshold effect are

a) Thermal noise

b) Interference from other users

c) Interference from circuit switching transients

d) All of the mentioned

7. When channel bandwidth is greater than the pulse bandwidth, it causes

a) Intersignal interference

b) Intersymbol interference

c) Bandwidth error

d) None of the mentioned

8. The_____corresponds to average quantization noise power.

a) Mean

b) Variance

c) Probability density function

d) None of the mentioned

9. Signal to noise ratio increases as_____increases.

a) Quantization level

b) Square of quantization level

c) Square root of quantization level

d) None of the mentioned

10. Signal to noise ratio is infinite when

a) Quantization noise is zero

b) Number of levels are infinite

c) Quantization noise is zero & Number of levels are infinite

d) None of the mentioned

11. The ratio of average signal power and quantization noise is

a) $3L^2$

b) $L^{2/3}$

c) $2L^3$

d) $L^{3/2}$