VALLIAMMAI ENGINEERING COLLEGE

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

SUBJECT: EC2301/ DIGITAL COMMUNICATION **SEM / YEAR : V / III**

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UNIT - I

DIGITAL COMMUNICATION SYSTEM

Part A

1. Define channel. What are the types of channel?
2. What is the function of formatter and de-formatter blocks in a digital system?
3. State the advantages & demerits of digital communication.
4. What is PAM and PWM?
5. How can we improve BER?
6. Why we go for Gram-schmidt orthogonalization procedure
7. Define absolute bandwidth
8. State Dimensionality theorem.
9. Write the applications of the dimensionality theorem.
10. State central-limit theorem.
11. Which parameter is called figure of merit of a digital communication system and why?
12. What is meant by distortion less transmission?
13. Draw the block diagram of digital communication system.
14. Define Half power bandwidth.
15. Define measure of information.

16. What is meant by symmetric channel?
17. Define spectral efficiency.
18. List out the mathematical models of communication channel.
19. Write the expression for Linear filter channel.
20. Which parameter is called figure of merit of a digital communication system and why?

Part B

1) Draw a neat block diagram of a typical digital communication system and explain the function of the key signal processing blocks. (16)
2) Explain how PWM and PPM signals are generated. Explain the concept of PWM and PAM. (16)
3) Explain any one analog pulse communication systems. (8)
4) Describe how channels can be classified and briefly explain each. (10)
5) Distinguish between baseband and bandpass signaling. (6)
6) Explain about the performance measure of digital communication system.(8)
7) Explain Gram-schmidt orthogonalization procedure. (16)
8) Explain any three communication channel models. (12)
9) Explain Binary symmetric channel and Gaussian channel with their mathematical models. (12)
10) Derive Geometrical representation of signal. (8)
11) Explain the procedure for obtaining from the basis set. (8)
12) Obtain the orthonormal basis function for the set of waveforms using GSOP. (16)

UNIT - II

BASEBAND FORMATTING TECHNIQUES

Part A

1. Define sampling theorem and list out its uses.
2. Compare uniform and non-uniform quantization.
3. Why is pre-filtering done before sampling?
4. What is natural sampling?
5. Define the term aliasing.
6. Compare DM and PCM.
7. Compare PCM and DPCM.
8. What is meant by quantization?
9. What is the need for non-uniform quantization?
10. State any two non-uniform quantisation 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 quadrature mirror filter (QMF)?
15. State sampling theorem for low pass signals.
16. What is slope overload? How it is reduced?
17. What is Companding?
18. Write a law of compression.
19. List out the various speech encoding technique.
20. What is temporal waveform coding? Mention its types.
21. Differentiate temporal waveform coding and model-based coding.
22. What is meant by temporal waveform coding?
23. Define adaptive transform coding (ATC).
24. What is the principle of linear predictive coder (LPC)?

Part B

1) State the Nyquist sampling theorem. Demonstrate its validity for an analog signal x(t) having a Fourier transform x(f) which is zero outside the interval ($-f_m < f < +f_m$). (16)
2) Explain (i) Impulse sampling and (ii) Natural sampling. (8)
3) Explain the process of quantization and obtain an expressions for signal to Quantization ratio in the case of a uniform quantizer. (10)
4) Explain in detail the various source coding techniques for speech signal and compare their performance. (16)
5) Explain a DPCM system. Derive the expression for slope overload noise. Show that SNR of DPCM is better than that of PCM. (16)
6) Explain the noises in delta modulation systems. How to overcome this effect in Delta modulation? (12)
7) Explain model based encoding technique. (8)
8) Describe temporal and spectral waveform encoding methods. (16)
9) With neat block diagram, pulse code modulation and demodulation system.(12)
10) Draw the block diagram of adaptive sub-band coding scheme for speech signal and explain. (8)
11) Explain the principle of LPC coder with diagram. (8)
12) Compare any two speech encoding techniques. (8)

UNIT – III

BASEBAND CODING TECHNIQUES

Part – A

1. What are the types of error control methods?
2. What is meant by channel coding?
3. Define coding efficiency.
4. Define code and block rate.
5. Define Hamming distance and calculate its value for two code words 11100 and 11011.
6. Define Hamming weight and minimum distance.
7. State the significance of minimum distance of a block code.
8. Write the advantages and disadvantages of Hamming codes.
9. Mention the properties of cyclic code.
10. What is line coding?
11. Define transparency of a line code. Give two examples of line codes which are not transparent.
12. State any 4 properties of a line code.
13. What is convolutional code? How is it different from block codes?
14. What is Manchester code? Draw its format for the data 10011.
15. Draw the RZ-Bipolar line code for the data 110100.
16. Draw the NRZ and RZ code for the digital data 10110001.
17. Mention the structural properties of a convolutional encoder.
18. What are the requirements of a line code?
19. What are the advantages and disadvantages of cyclic code?
20. What is Viterbi decoding scheme?
21. Define channel efficiency.
22. Write syndrome properties of linear block codes.

1) 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:

$$P_1 = I_1 + I_2$$
$$P_2 = I_1 + I_3 \quad (16)$$
$$P_3 = I_2 + I_3$$

2) Explain how encoding is done by convolutional codes with an example.(10)

3) Explain tree diagram, trellis diagram and state transition diagram of convolutional codes. (12)

4) Construct a single error correcting (7, 4) linear block code and the corresponding decoding table. (12)

5) Describe the steps involved in the generation of linear block codes. Define and explain properties of syndrome. (10)

6) Find a generator polynomial for a (7, 4) cyclic code and hence find the code word for [1 0 0 0]. (8)

7) Briefly describe the concept of error-free communication. (6)

8) Consider a (7, 4) linear block code whose parity check matrix is given by

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

(a) Find the generator matrıx.
(b) How many errors this code can detect?
(c) How many errors can this code be corrected?
(d) Draw circuit for encoder and syndrome computation. (16)

9) Explain the Viterbi algorithm assuming a suitable convolutional coder and received bit stream.

10) Derive the power spectral density of polar signaling and explain.

11) Derive the expression for power spectral density of unipolar NRZ line code. Hence discuss its characteristics. (16)

12) Design a convolutional coder of constraint length 6 and rate efficiency 1/2. Draw its tree diagram and trellis diagram. (16)

13) List and explain the properties of line codes. (8)

Unit - IV
BASEBAND RECEPTION TECHNIQUES

Part A

1. What is the need for a demodulator in case of baseband signaling when the received waveforms are already in pulse like form?
2. List out the important sources of noise.
3. What is correlator?
4. A 64 Kbps binary PCM polar NRZ signal is passed through a communication system with a raised-cosine filter with roll-off factor 0.25. Find the bandwidth of the filtered signal.
5. Sate Nyquist criterion for zero ISI.
6. Define an ideal Nyquist channel.
7. Mention the advantages and drawbacks of ideal Nyquist filter.
8. What is meant by correlative coding?
9. What is ISI?
10. 'ISI can-not be avoided'. Justify the statement.
11. Why do we need equalization filter?
12. What are the properties of matched filter?
13. Define duo binary system. What are the drawbacks of it?
14. State the principle of maximum likelihood detectors.
15. What is the information that can be obtained from eye pattern regarding the signal quality?
16. State any 2 applications of eye pattern.
17. Bipolar pulse waveforms $g_i(t)$ (i = 1, 2) of amplitude ±1 V are received in the presence of AWGN that has a variance of 0.1 V^2. Find the optimum detection threshold γ of MAP detector, if a priori probability is $p(g_i) = 0.5$.
18. How does pulse shaping reduce ISI?
19. Mention the 2 factors that contribute to pulse distortion in switched telephone network.
20. What are the types of synchronization methods available?
21. Define power spectrum of a signal

Part B

1) Describe with neat diagram the functioning of a correlator type receiver.(10)
2) Explain the equivalence between correlator and mismatched filter receiver.(8)
3) What is matched filter? Derive the expression for the impulse response of a matched filter. (16)
4) What does the term equalization refer to? Explain how it is carried out by using transverse filters. (12)
5) Describe coherent detection using maximum likelihood detector. (8)
6) Derive the expression for bit error probability of a binary signal detected with a matched filter. (8)
7) Explain modified duo-binary signaling scheme without and with procedure.(12)
8) Explain zero-forcing equalizer with neat diagram. (10)
9) Derive the expression for error probability of on-off and polar signaling.(10)
10) Describe any one method to minimize ISI. (8)
11) List the inferences made from the eye pattern. (6)
12) Explain a method of bit synchronization. (6)
13) Explain the various types of equalization technique used in data transmission system. (10)
14) Derive the bit error probability for M-ary orthogonal signal.
15) Draw the block diagram of duo-binary signaling scheme for controlled ISI. Explain the scheme with and without precoder. (10)

UNIT- V

BANDPASS SIGNAL TRANSMISSION AND RECEPTION

Part A

1. Define QAM and draw its constellation diagram for M=8.
2. Mention the drawbacks of ASK.
3. Why is PSK always preferable over ASK in Coherent detection?
4. What are the drawbacks of binary PSK system?
5. Draw the PSK waveform for 011011.
6. What are the advantages of QPSK over PSK?
7. Define BPSK and DPSK.
8. What is the difference between PSK and FSK?
9. What is QAM?
10. Write the special features of QAM.
11. What are coherent systems?
12. Differentiate coherent and non-coherent detection'
13. What is constellation diagram?
14. List out the difference between carrier recovery and clock recovery.
15. A binary FSK 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.
16. Compare the error probability for BPSK and QPSK.
17. 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 bit error probability?
18. What is meant by memoryless modulation?
19. Define modulation rate.
20. What is the error probability of MSK & DPSK?

Part B

1) Explain the generation, detection, signal space diagram of ASK system.(12)

2) Describe with diagrams the generation and detection of coherent binary FSK. Explain the probability of error for this scheme. (16)

3) Explain non coherent detection methods of binary frequency shift keying scheme. (12)

4) Derive the expression for bit error probability of a
   (i) Coherent ASK system. (8)
   (ii) non-coherent FSK system. (8)

5) Explain the generation and detection of binary PSK. Also derive the probability of error for PSK. (16)

6) Discuss about coherent detection of QPSK and non-coherent detection of ASK. (12)

7) Describe with signal space diagram quadrature amplitude modulation and its differences with respect to QPSK. (10)

8) Derive the expression for error probability of QAM system. (8)

9) Derive the expression for bit error probability of a QPSK system. (8)

10) Explain the principle of DPSK system with the help of suitable circuit. (8)

11) Compare the performance of various digital modulation schemes. (8)

12) 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 $\eta = 10^{-12}$ W/Hz at the receiver. Determine the transmitted power for a bit error probability $P_e = 10^{-3}$ for the following modulation schemes.
   (i) Coherent ASK (ii) Non-coherent ASK
   (iii) FSK (iv) PSK
   (iv) DPSK (vi) 16 QAM

13) Compare the performance of various coherent and non-coherent digital detection systems. (12)