**PRATHYUSHA ENGINEERING COLLEGE**

**DEPARTMENT OF ECE**

**EC8501-DIGITAL COMMUNICATION**

**QUESTION BANK**

## UNIT I INFORMATION THEORY

### Part A

1. Define mutual information and channel capacity.
2. Demonstrate entropy for a discrete memory less source.
3. Point out the source coding techniques
4. Give the expression for code efficiency in terms of entropy.
5. Outline about prefix code.
6. Calculate the channel capacity of binary synchronous channel with error probability of 0.2.
7. Recall information rate.
8. Differentiate between lossless and lossy coding.
9. A source generate three message with probability 0.5, 0.25, 0.25 calculate source entropy.
10. Define Information theory?
11. Define discrete memoryless source.
12. Define Uncertainty.
13. Define entropy.
14. List out the properties of entropy.
15. Define mutual information.
16. Give properties of mutual information.
17. Define channel capacity
18. State channel capacity theorem.

**Part B**

1.Explain in detail about Shannons theorem

(i) Source coding theorem

(ii) Channel coding theorem

(iii) Shannon Hartley or information capacity theorem) with expressions.

2. Construct the binary optimal code for the following probability symbols using Huffman Coding and

| Symbols | S0 | S1 | S2 | S3 | S4 | S5 | S6 |
|---|---|---|---|---|---|---|---|
| Pk | 0.125 | 0.0625 | 0.25 | 0.0625 | 0.125 | 0.125 | 0.25 |

(i) Calculate Entropy(3)

(ii) Average No. of bits (3)

(iii) Calculate its efficiency (7)

3. Discuss about the

(i) Objective of Channel Capacity (4)

(ii) Channel capacity with expressions (9)

4. Discuss in detail about the Discrete Memoryless Channel and also explain

(i) Binary Communication Channel,

**(ii)** Binary Symmetric Channel with Channel Capacity (C) (13)

5. Define Entropy and list out the properties of entropy.

6.Determine the Huffman code and Shannon-Fano code for the following messages with their probabilities given.

| X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 0.05 | 0.15 | 0.2 | 0.05 | 0.15 | 0.3 | 0.1 |

(i) Calculate Entropy
(ii) Calculate Average No. of bits
(iii) Calculate its efficiency (13)

7.Formulate the following using Huffman codin{.02,0.1,0.38,0.3} (13)

8. A discrete memoryless source emits 5 symbols whose associated probabilities are {0.4,0.19,0.16,0.15,0.1}. Construct the Shannon fano code and determine the efficiency. (13)

9.Deduce the proof of various Shannon's theorem. (8)

10.Propose the ideas about channel capacity, coding, efficiency and redundancy. (13)

11.Identify about the lossy source coding schemes. (6)

## UNIT IIWAVEFORM CODING& REPRESENTATION

### Part A

1. What are the advantages of ADM. (May 2010)
2. What are the advantages of delta modulator (May 20106
3. Draw the block diagram of the transmitter and receiver sections of ADM.
4. What is linear predictor. On what basis are the predictor coefficients determined. (May 2016)
5. What are the two types of quantisation errors in delta modulation. (May 2010)
6. What is meant by Linear Predictive coding.
7. Draw the block diagram of the transmitter and receiver sections of LPC.
8. What are the two types of adaptive prediction.
9. What are the limitations of delta modulation? (or) What are the 2 errors that occur in delta modulation.
10. What is slope overload error? How it can be minimized?
11. State the advantages and disadvantages of DPCM.

12. Draw the block diagram of the transmitter and receiver sections of DPCM.
13. Draw the NRZ and RZ code for the digital data 10110001.
14. What is line coding. (Nov 2014)
15. What are line codes? Name some popular line codes. (May 2016)
16. State any four desirable properties of a line code. (Nov 2012)
17. Construct the NRZ bipolar and Manchester format for the binary sequence 011010110.
18. Define transparency of a line code. Give 2 examples of line codes which are not transparent. (May 2013)
19. What is Manchester coding? What are its advantages. (Nov 2014)

**Part B**

1. Explain a DPCM system. Show that SNR of DPCM is better than that of PCM.(16) (Nov 2012)
2. Draw the block diagram of ADPCM system and explain its function.(10) (May 2016)
3. i)With neat block diagrams explain the operation of Delta Modulation. (8)
   ii) Explain the operation of Adaptive Delta Modulation. (8)
4. i) Explain Linear Predictive coding. (or) model base coding. (8)
   ii) Briefly explain the operation of Prediction filtering. (8)
5. Draw the block diagram of an adaptive delta modulator with continuously variable step size and explain.(10) (May 2016)
6. Sketch the power spectra of ( a)Polar NRZ and ii)Bipolar RZ signals. (8 ) (May 2016)
7. Derive and explain the power spectral density of ON-OFF code and Polar code. (16) (May 2015)
8. Derive and draw the power spectra of a NRZ,( i)Polar Coded waveform ,(ii)bipolar coded waveform. (16)(May 2013)
9. Compare the various line coding techniques and list their merits and demerits.(8) (May2016)

10. Derive the expression for power spectral density of unipolar NRZ line code. Hence discuss its characteristics. (8)
11. Compare the power spectra of different binary formats. (16)
12. State the properties of line codes. (6)
13. Derive and draw the power spectra of a NRZ polar coded waveform and NRZ bipolar coded waveform. (8)

## UNIT III BASEBAND TRANSMISSION & RECEPTION

### Part A

1. Give four applications of eye pattern. (May 2015)
2. What is ISI and what are the causes of ISI? (Nov 2014,May 2016)
3. What is meant by correlative coding. (May 2010)
4. State Nyquist criterion for zero ISI.
5. ISI cannot be avoided. Justify the statement. (May 2013)
6. What is meant by pulse shaping?
7. How does pulse shaping reduce inter symbol interference. (Nov 2010)
8. What is the function of an equalizing filter. (Nov 2014)
9. Define transparency of a line code. Give 2 examples of line codes which are not transparent. (May 2013)
10. A TDM signal with bit time of 0.5μs is to be transmitted using a channel with raised cosine roll off factor of 0.5. What is the bandwidth required?
11. What is the use of eye pattern. (Nov 2014)
12. What is a matched filter? (April 2011)

### Part B

1. Explain the Nyquist first criterion for ISI elimination. (16 ) (May 2013, May2010)
2. Describe how eye pattern can be obtained and can be used for observing the characteristics of a communication channel. (8)
3. What does the term equalization refer to? Explain how it is carried out byusing transversal filters.

(16) (Nov 2010)

4. Explain duo-binary signalling scheme without and with precoder. (9) (May 2016)
5. Explain the adaptive equalization with block diagram. (7) (May 2016,May 2010)
6. What is meant by Correlative coding. Briefly explain. (or) Explain Nyquist second criteria.
7. Write briefly about eye patterns. (6)(May 2016)
8. Explain modified duo-binary signalling scheme without and with precoder. (16)(Nov 2012)
9. Define a matched filter and compare its functioning with a correlation receiver. ( 10) (April 2011)
10. Explain how a matched filter can maximize SNR for a given transmitted symbol. (6)
11. Derive the expression for bit error probability due to a matched filter. (10)
12. Explain the working principle of Maximum Likelihood detector. (10) (April 2011)
13. Explain the working of a correlator type receiving filter. (12) (Nov 2012)

## UNIT IV

## DIGITAL MODULATION SCHEME

### Part A

1. What are coherent and non- coherent receivers. (May 2013,May 2015)
2. What are coherent systems. (Nov 2014)
3. What is meant by memorylessmodulation. Give examples of 2 such methods.(May2015)
4. Define QAM and draw its constellation diagram. (Nov 2014,Nov 2010)
5. What is QAM? (May 2013)
6. Distinguish between coherent and non- coherent reception. (May 2016)
7. Mention the advantages of PSK systems. (Nov 2014)
8. Mention the drawbacks of amplitude shift keying. (Nov 2014)
9. How can BER of a system be improved. (Nov 2012)
10. Bring out the difference between carrier recovery(synchronization) and clock recovery.

11. What are basis functions?

12. What are the advantages and disadvantages of DPSK?

13. Write the expression for bit error rate for coherent binary FSK.

14. What is QPSK? Write the expression for the signal set of QPSK. (May 2016)

15. Compare BPSK and QPSK in terms of their bandwidths and their error performance.

16. Define BER.

17. Draw the constellation diagram (signal space diagram) for BPSK,QPSK.

16.State the condition for a set of basis functions to be orthonormal.

17.Define error probability. (May 2010)

**Part B**

1. Derive the bit error probability or BER of QPSK Receiver. (16) (May 2013)

2. Derive the bit error probability or BER of coherent ASK and non-coherent FSK system. (16) (May 2013)

3.Derive the bit error probability or BER of coherent FSK and PSK Receivers.

1. Explain Gram-Schmidt orthogonalisationprocedure(GSOP) or Explain the geometrical representation of signals. (8 marks) (May 2015,Nov 2014,Nov 2012)
2. Describe non coherent and coherent FSK demodulation. And obtain the probability of error of a FSK system.
3. Explain the non- coherent detection of FSK signal and derive the expression for probability of error. (16) (May 2016)
4. Explain the generation and detection of a coherent binary PSK signal and derive the power spectral density of binary PSK signal and plot it. (16) (May 2016)
5. Describe non- coherent and coherent FSK demodulation. (8) (Nov 2014)
6. Describe with diagrams, the generation and detection of coherent binary FSK. Explain the probability of error for this scheme. (16) (Nov 2013)

10.Explain the generation and detection of binary PSK. (8) (Nov 2013)

11.Derive the expression for probability of error of BPSK and QAM system. (16)

(May 2010)

13. Explain the working of DPSK scheme. With help of suitable circuit. (6) (May 2010)

Explain QPSK modulation. Describe with a block diagram the operation of a QPSK transmitter. (10 marks) (Nov 2014)

14. Explain the bandwidth considerations of QPSK. (6 marks) (Nov 2014)
15. Derive the bit error probability of coherent ASK, FSK,PSK receivers. (16 marks) (May 2013)
16. Derive the bit error probability of BPSK and QAM system.(16) (May 2010)
17. Explain carrier synchronization. (10)
18. Compare the performance of various coherent and non–coherent digital detection systems. (16)
19. Discuss the representation and spectral characteristics of PSK, QAM,QPSK and FSK signals. (16)

## UNIT V

## ERROR CONTROL CODING

### Part A

1. Define Hamming distance and Hamming weight. (May 2015,May 2010)
2. Define code rate of a block code. (Nov 2014)
3. Find the Hamming distance between 101010 and 010101. If the minimum Hamming distance of a (n,k ) linear block code is 3, what is its minimum Hamming weight? (Nov 2012)
4. Define constraint length and code rate of a convolutional coder. (May2015, May 2016)
5. What is the need for error control codes? (Nov 2014)
6. State the significance of minimum distance of a block code. (May 2013)
7. What is a linear code. (May 2016)
8. Define Hamming code.
9. What is meant by syndrome of a linear block code?
10. Define minimum distance.
11. Define Hamming distance and based on that give the error correction and error detection capacity of a linear block code.
12. What are the fundamental properties exhibited by cyclic codes?
13. What is convolutional code?

14. List the differences between block codes and convolutional codes.

15. Define Hamming distanceand calculate its value for two code words 11100 and 11011.

(Nov 2010)

**Part B**

1. Consider a linear block code with generator matrix (3+3+6+4)
   1 1 0 1 0 0 0
   0 1 1 0 1 0 0
   1 1 1 0 0 1 0
   1 0 1 0 0 0 1.
   i)Determine the parity check matrix.
   ii)Determine the error detecting and capability of the code.
   iii)Draw the encoder and syndrome calculation circuits.
   iv)Calculate the syndrome for the received vector r= [1101010]. (May 2016)

2. Explain Viterbi decoding algorithm for convolutional code. (8)
   (May 2016,May 2010)
3. The generator polynomial of a (7,4) cyclic code is $1+X+X^3$.Develop encoder and syndrome calculator for this code. (8) (May 2016)
4. Explain Viterbi algorithm to decode a convolutional coded message with a suitable example. (16)
   (May 2013)
5. Describe the steps involved in the generation of linear block codes. Define and explain the properties of syndrome. (16 marks) (Nov 2013)

6. Explain the generation of (n,k) block codes and how block codes can be used for error control.
   (10 marks) (Nov 2014)

7. Consider a (6,3) block code and explain how error syndrome helps in correcting a single error for a data 110. (6 marks) (Nov 2014)
8. Describe how convolutional codes can be generated with an example. Draw and explain the tree diagram and trellis diagram representation of convolutional codes.
   (16) (Nov 2014)
9. Explain Channel coding theorem. (6)
10. 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 $P_1$, $P_2$, $P_3$ from the information bits as follows : $P_1 = I_1 \oplus I_2$, $P_2 = I_1 \oplus I_3$, $P_3 = I_2 \oplus I_3$.
    Find (i) The parity check matrix
    (ii) The generator matrix
    (iii) All possible code words.
    (iv) Minimum weight and minimum distance and
    (v) The error detecting and correcting capability of the code.

(vi) If the received sequence is 10,0000. Calculate the syndrome and decode the received sequence. (16 marks) (Nov 2010)

11. Generate the cyclic code word for (7,4) hamming code (8)
12. Consider a (7,4) linear block code with the parity check matrix H given by
    1 0 1 1 1 0 0
    1 1 0 1 0 1 0
    0 1 1 1 0 0 1.
    Construct the code words for this code. Show that this code is a Hamming code . Illustrate the relation between the minimum distance and the structure o the parity check matrix H by considering the code word 0101100. (16)
13. A convolutional code is described by the following generated sequences $g^{(1)}$=(1 0 1), $g^{(2)}$=(1 0 0), $g^{(3)}$=(1 1 1).
    1. Draw the encoder of this code. (2)
    2. Draw the state diagram. (4)
    3. If the message sequence is 10110 determine the code word. (2)
14. Design a convolutional coder of constraint length 6 and rate efficiency ½. Draw its tree diagram and trellis diagram. (10)
15. Explain in detail the coding and decoding of linear block codes. (10)

16. For the convolutional coder shown in figure draw the state diagram and hence the trellis diagram. The input sequence is 11010100.(8)