Enrollment No......................................

Faculty of Engineering

End Sem Examination Dec-2023

EC3CO11 Digital Communication

Programme: B.Tech.   Branch/Specialisation: EC

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The maximum permissible distance between two samples of a 2 kHz **1** signal is-
(a) 1000 µ sec   (b) 500 µ sec
(c) 250 µ sec   (d) 125 µ sec

ii. The main advantage of TDM over FDM is that it- **1**
(a) Needs less power   (b) Needs less bandwidth
(c) Needs simple circuitry   (d) Gives a better S/N ratio

iii. The advantage of using source coding is- **1**
(a) It reduces the information rate
(b) It reduces the required bandwidth for transmission of data
(c) It reduces error
(d) It increases the bit rate

iv. In which line coding technique opposite polarity pulses of amplitude **1** ±A/2 are used to represent logic 1 and 0?
(a) Unipolar NRZ   (b) Polar NRZ
(c) Bipolar NRZ   (d) AMI

v. In Amplitude Shift Keying, the transmission bandwidth is equal to- **1**
(a) Baseband signal bandwidth
(b) Twice of the Baseband signal bandwidth
(c) Half of the Baseband signal bandwidth
(d) One and a half of the Baseband signal bandwidth

vi. The number of basis-functions utilized in Frequency Shift Keying is- **1**
(a) Always equal to one
(b) Minimum
(c) Equal to the number of symbols
(d) Equal to bits per symbol

vii. A given source will have maximum entropy if the messages produced **1**
are-
(a) Two in number   (b) Mutually exclusive
(c) Statistically independent   (d) Equiprobable

viii. Which of the following is not a unit of information? **1**
(a) Bit   (b) Nat   (c) Decit   (d) Hz

ix. A parity check code can- **1**
(a) Detect a single-bit error   (b) Correct a single-bit error
(c) Detect two-bit error   (d) Correct two-bit error

x. The hamming distance between two codes is defined as- **1**
(a) Number of zeros in which binary codes differ
(b) The number of ones in the binary codes differ
(c) Number of positions at which binary bits differ
(d) Number of ones minus the number of zeros in binary codes

Q.2 i. Explain the two fundamental limitations of a communication system. **2**
ii. Draw a neat and clean block diagram of the digital communication system and explain each block properly. **8**
OR iii. Explain pulse code modulation and demodulation using its block diagram. **8**

Q.3 i. What do you mean by inter symbol interference? **2**
ii. Draw various line coding waveforms with a clock signal for the binary stream 110001 and proper labelling of voltage levels. **8**
OR iii. Explain Maximum Likelihood (ML) and Maximum Aposteriori Probability (MAP) detectors considering a binary symmetric channel. Why MAP is an optimum receiver? **8**

Q.4 i. Differentiate between baseband and passband signals and draw a typical spectrum of each. **3**
ii. What is the basic purpose behind the use of spread spectrum techniques? Explain the direct sequence spread spectrum with block diagrams of the transmitter and receiver. **7**
OR iii. Explain QPSK passband modulation under the following heads: **7**
(a) Expression of transmitted signal
(b) Expressions of basis functions
(c) Signal space diagram
(d) Block diagrams of generator and detector with explanation

Q.5 i. Explain the bandwidth and SNR trade-off by an example. **3**

ii. A discrete source transmits messages x1, x2 and x3 with the probabilities 0.3, 0.4 and 0.3 respectively. The source is connected to the channel given in the figure. Calculate two marginal entropies, two conditional entropies and the joint entropy. **7**
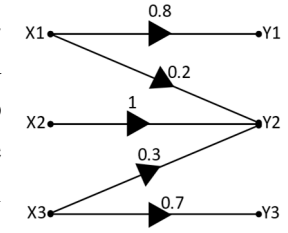
Figure: Channel

OR iii. Apply the Shannon-Fano coding procedure for the following message ensemble and calculate the following: **7**
(a) The average length of the message
(b) The entropy of the source
(c) Coding efficiency

$$[x] = [x1 \quad x2 \quad x3 \quad x4 \quad x5 \quad x6 \quad x7 \quad x8]$$
$$[P] = [1/4 \quad 1/8 \quad 1/16 \quad 1/16 \quad 1/16 \quad 1/4 \quad 1/16 \quad 1/8]$$

(Take M = 2)

Q.6 i. What is hamming distance? Explain its importance in error detection and correction. **3**
ii. Consider a (7,4) block code generated by- **7**

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & \vdots & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & \vdots & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & \vdots & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & \vdots & 1 & 1 & 1 \end{bmatrix}$$

Explain how the error syndrome S help in correcting a single error. What happens when more than one error occurs?

OR iii. Explain the encoder structured with shift registers and decoder using code tree for the convolution code. **7**

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