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Total No. of Questions : 08

**M.Tech.(ECE)    (Sem.–2)**
# INFORMATION THEORY & CODING
**Subject Code : EC-509**
**Paper ID : [E0568]**

Time : 3 Hrs.                 Max. Marks : 100

**INSTRUCTION TO CANDIDATES :**
1. **Attempt any FIVE questions out of EIGHT questions.**
2. **Each question carries TWENTY marks.**

1. a) Derive the expression for an amount of information for single message and multiple messages.

   b) Show that $H(x,y) = H(x/y)+H(y)$.

2. a) Explain Shannon's second fundamental theorem on coding for memory less noise channels.

   b) Show that for a discrete channel $I(x,y) >= 0$.

3. Consider the binary block code C composed of the following four code words :
   $C = \{(00100), (10010), (01001), (11111)\}$

   a) What is the number of information bits, *K*?

   b) What is the number of parity-check bits, *c*?

   c) What is the minimum distance of this code?

   d) What is the maximum weight for which the detection of all error patterns is guaranteed?

   e) What is the maximum weight for which the correction of all error patterns is guaranteed?

   f) Is this code linear? Prove your answer.

4.   Give the brief description of cyclic codes and how the parity check matrix can be generated for the cyclic codes.

5.   a) Consider a discrete memory less source with alphabet $[S_0, S_1, S_2]$ and statistics. $\{0.7, 0.15, 0.15\}$ for its output :

   i)   Apply Huffman algorithm to this source, hence show that average code length of Huffman code equals 1.3 bits/symbol.

   ii)  Let the source be extended to order two, apply the Huffman algorithm to the resulting extended source and show that the average code world length of the new code equals 1.1975 bits/symbols.

   iii) Compare the average code world length calculate in part (2) with entropy of original source.

   b) Explain the difference between PAM, PWM & PPM modulations.

6.   a) Draw the block diagram of coherent QPSK receiver and explain its working.

   b) Binary data is transmitted over a communication link at a rate of $10^6$ bits per second and with noise power spectral density at the input of receiver as $10^{-10}$ watts per hertz. Find out the average carrier power required to maintain an average probability of error $Pe \leq 10^{-4}$. What is the required channel bandwidth?

7.   a) The generator polynomial of a (7,4) cyclic code is $g(x) = 1+x+x^3$. Find the 16 code words of this code.

   b) Compare and contrast cyclic codes with convolutional codes.

8.   a) What is meant by aliasing? What can be done to reduce aliasing? Also determine the Nyquist sampling rate and Nyquist sampling interval for signal

   $X = Sin(100\pi t) + Sin (50\pi t)$

   b) What are the advantages of the non-coherent detection of the signal, and explain with diagram the non coherent binary amplitude shift keying?