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M. Tech 1st Semester Examination

Information Theory & Random Signals

EC-105

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt any Five Questions. All the questions carry equal marks. Assume suitable data if necessary.

1. (a) A source generates 5 messages with probability of occurrence as shown below:

Message	m_0	m_1	m_2	m_3	m_4
Probability	0.55	0.15	0.15	0.10	0.05

Apply Huffman coding algorithm and place the combined message as low as possible when its probability is equal to that of another message.

   (i) Calculate the codewords for the messages.

   (ii) Calculate average codeword length.   (12)

   (b) State and prove the theorems of log sum inequality. (8)

2. (a) State and prove joint channel coding theorem.   (10)

   (b) Prove that $I(X:Y)=H(X)+H(Y)-H(X,Y)$ (10)

3. (a) Explain the effect of channel capacity when Gaussian channels are used (i) with feedback (ii) without feedback. (10)

   (b) Explain the significance of Hidden Markov Model and how these are different from Markov process? (10)

4. (a) Discuss the various properties of rate distortion function. (10)

   (b) Explain the various types of random variables. (10)

5. (a) Compute the cumulative distribution function of Gaussian random variable. (10)

   (b) State and prove the properties of autocorrelation function of random process. (10)

6. (a) The generator polynomial of a (7,4) cyclic code is $G(p)=p^3+p+1$. Find all the code vectors for code in nonsystematic and systematic form. (12)

   (b) Compare linear block codes, cyclic codes and convolutional codes by giving their advantages and disadvantages. (8)

7. Fig. 1 shows the block diagram of the binary convolutional encoder.
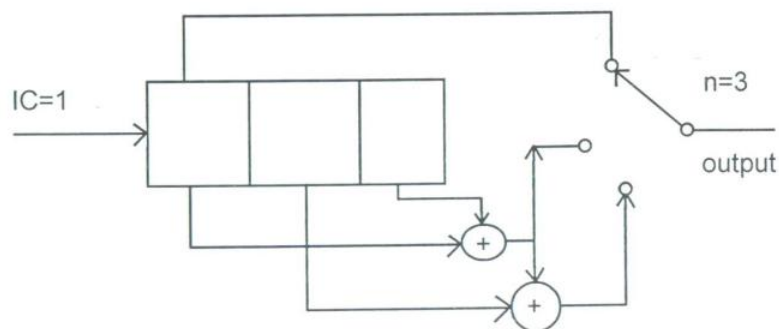

Fig. 1

   (a) Draw the state diagram and code trellis for this encoder.

   (b) Assume that a message has been encoded by this code and transmitted. If the received sequence is Y=(110, 110, 110, 111, 010, 101, 101).

   Using Viterbi Algorithm, decode Y and find out the transmitted bit sequence. (20)

8. Discuss the followings:

   (a) Poison Distribution

   (b) RSA algorithm

   (c) Covariance (20)