**The LNM Institute of Information Technology**

**Department of Electronics &Communication Engineering, Sub: Cognitive Radio**

**Quiz-2, 8 April, 2020, Time Duration: 45 minutes, Maximum Marks: 5 x 10 = 50**

**Q1.**

1. M fair coins are thrown where all possible outcomes are *2M*. The entropy of this scheme is:

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1. What is the entropy of the English alphabet considering all 27 letters are equi-probable?

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1. For a BSC with error probability *p = 0.1* and equally likely input symbols i.e. *p(x1) = p(x2) = 0.5.* Find *H(X, Y)*.

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1. For the above mentioned problem, calculate *I(X, Y)*.

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1. Write down the channel matrix for a binary (4x4) noiseless channel. What is equivocation?

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**Q2.**

1. For a source alphabet *X* of two symbols with probabilities of *p* and *q = 1-p*, find *H(x).* Plot *H(x*) versus *p* and indicate the value of *p* where *H(x)* is maximum.

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1. The channel matrix of an erasure channel is given as

Draw the corresponding channel diagram

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**Q3.**

1. Define the ergodic capacity of a fading channel. Is the relation true?

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1. Consider a flat channel with channel gain coefficient with,, with respective probability , and . Find the average SNR, given and *B = 30 KHz*. Also find the capacity of the channel.

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**Q4.**

1. The transition probabilities of a noisy binary communication channel is shown in Fig. 1

A picture containing sitting, red, photo, wire

Description automatically generated

Figure 1

Given that the source delivers binary digits 0 and 1 [*P(0) = P(1) = 0.5*] at a rate of 1000 digits per seconds, Find the rate at which information is received.

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1. A source generates four symbols A, B, C and D at a rate of 2000 symbols/sec. Determine the source information rate if the probability of occurrence of symbols are: *p(A) = 0.25. p(B) = 0.5, p(C) = 0.125* and *p(D) = 0.125*.

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**Q5.**

1. Compute *I(X, Y)* for the BSC with error probability *p = 0.1* and equally likely input/output symbols i.e. *p(x1) = p(x2) = 0.5 = p(y1) = p(y2)* (Hint: Use I(X, Y) = H(X) + H(Y) – H(X, Y))

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1. Find the capacity of a telephone channel with bandwidth B = 3KHz, and SNR = 40 dB

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