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B.E. / B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2012

ELECTRONICS AND COMMUNICATION ENGINEERING BRANCH

SEVENTH SEMESTER

EC9027 - INFORMATION THEORY

Time: 3 hrs (REGULATIONS 2008) Max Mark: 100

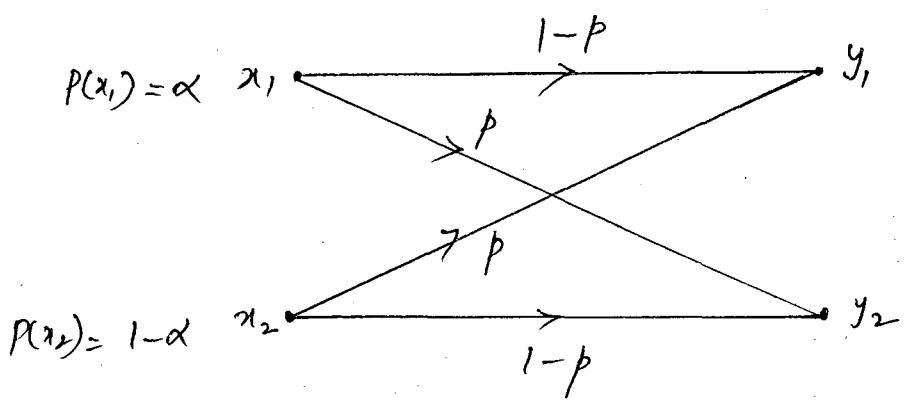
Answer ALL Questions

Part – A (10 X 2 = 20 Marks)

1. Define Cramer Rao inequality.
2. Verify, $I(x_ix_j)=I(x_i) + I(x_j)$ if x_i and x_j are independent.
3. Define Expected Length of a Source Code.
4. Consider an AWGN channel with 4-kHz bandwidth and the noise power spectral density $\eta/2 = 10^{-12}$ W/Hz. The signal power required at the receiver is 0.1 mW. Calculate the capacity of this channel.
5. State the properties of channel capacity.
6. Find the capacity of a weakly symmetric channel.
7. If X,Y have a joint density function f(x,y), Write the expression of conditional differential entropy h(X/Y).
8. Describe the capacity of the time-varying Gaussian channel without feedback.
9. Draw the diagram of Gaussian interference channel.
10. State Broadcast channel.

Part – B (5 X 16 = 80 Marks)

11. (a). (i). Consider a BSC given below with $P(x_1)=\alpha$, Show that the mutual information I(X,Y) is given by $I(X,Y) = H(Y) + p \log_2 p + (1-p) \log_2(1-p)$ (6)
(ii). Calculate I(X,Y) for $\alpha = 0.5$ and $p= 0.1$ (5)
(iii) Calculate I(X,Y) for $\alpha = 0.5$ and $p= 0.5$, and comment on the result. (5)



12. (a).(i). Discuss Data compression techniques with an Example. (8)

(ii). Explain Rate Distortion Theory in detail. (8)

(or)

(b).(i). Explain the Asymptotic Equipartition property in detail and derive its Codeword length. (10)

(ii). A DMS X has five symbols x_1, x_2,x_3,x_4 and x_5 with respective probabilities 0.2,0.15,0.05,0.1 and 0.5. Construct Shannon Fano code for X and calculate code Efficiency and Repeat with Huffman code. (6)

13. (a).(i). Find the channel capacity of the binary Erasure channel. (10)

(ii). Discuss the capacity of a Discrete memoryless channel with feedback. (6)

(or)

(b). (i). Explain the Joint source channel coding theorem in detail. (8)

(ii). Two random variables X€ {0,1} and Y€{0,1} , with joint probability distribution $P_{XY}(x,y)$ given by: $P_{XY}(0,0)=1/2$, $P_{XY}(0,1)=1/6$, $P_{XY}(1,0)=1/6$, $P_{XY}(1,1)=1/6$. Calculate H(X,Y),H(X),H(Y),H(X/Y=0),H(X/Y=1),H(Y/X) and the Channel Capacity. (8)

14. (a). (i). Discuss Joint and Conditional differential Entropy in detail. (6)

(ii). List the properties of Differential entropy, Relative Entropy and Mutual information. (10)

(or)

(b). Explain Band – Limited channels in detail. (16)

15. (a). Explain in detail about the Independent binary symmetric channels, Binary multiplier channel, Binary erasure multiple access channel with an Example. (16)

(or)

(b). Write short notes on,

(i). Gaussian Multiple Access Channel with m users. (5)

(ii). Gaussian Broadcast Channel. (5)

(iii). Gaussian Relay Channel. (6)