Exam Seat No:_______________ Enrollment No:___________________

C.U.SHAH UNIVERSITY

WADHWAN CITY

University (Winter) Examination -2013

Course Name: M.Tech(EC) Sem-I **Subject : Information Theory & Coding** **Marks :70**

Duration :- 2:30 Hours **Date : 06/01/2014**

Instruction

(1) Attempt all Questions of both sections in same answer book / Supplementary.
(2) Use of Programmable calculator & any other electronic instrument is prohibited.
(3) Instructions written on main answer Book are strictly to be obeyed.
(4) Draw neat diagrams & figures (If necessary) at right places.
(5) Assume suitable & Perfect data if needed

SECTION – I

Q.1	(a)	Explain Conditional Probability.	02
	(b)	Explain Probability Density Function.	02
	(c)	Explain uniquely decodable code with suitable example.	02
	(d)	What is Independent events?	01
Q.2	(a)	State and prove the Bay's theorem.	05
	(b)	If X and Y are uncorrelated and have zero means than prove that $E\{(X+Y)^2\}= E(X^2)+E(Y^2)$.	05
	(c)	What is an Instantaneous code? Describe the procedure to construct a binary instantaneous code.	04
		OR	
Q.2	(a)	State and prove the Kraft's Inequality.	05
	(b)	Find the CDF of the Gaussian Random Variable whose PDF is given by $f_X(x)=\frac{1}{\sqrt{2\pi\sigma}}e^{-(x-\mu)^2/2\sigma^2}$	05
	(c)	The PDF of amplitude X of a certain signal x(t) is given by $P_x(x)=0.5\lvert x\rvert\cdot e^{-\lvert x\rvert}$. Find the probability that (i) $x\geq 1$. (ii) $-1\leq x\leq 2$.	04
Q.3	(a)	Derive the mean and variance of Exponential random variable whose PDF is given by $f_X(x)=\lambda e^{-\lambda x}$.	07
	(b)	The Joint PDF of random variable X and Y is given by $P_{xy}(x,y)=K\cdot e^{-(x^2+xy+y^2)}$ Determine (i) the constant K (ii) $P_x(x)$ (iii) $P_y(y)$.	07
		OR	
Q.3	(a)	Derive the mean and variance of Poisson random variable whose PDF is given by $f_X(x)=e^{-\lambda}\frac{\lambda^K}{K!}$.	07
	(b)	Write short note on Ergodic Process.	07

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SECTION – II

Q.4	(a)	Explain the source Entropy.	02
	(b)	Define (i) Information Rate (ii) Code Rate.	02
	(c)	Explain the Binary Symmetric Channel.	02
	(d)	What is conditional entropy?	01

Q.5 (a) Encode the sequence "BADF" using Arithmetic coding for the symbols with following probability distribution: 05

Symbol	A	B	C	D	E	F	G	H
Length	0.1	0.2	0.1	0.3	0.05	0.1	0.05	0.1

(b) Write short note on Mutual Information. 05

(c) An analog signal is bandlimited to 10KHz is quantized in 8 levels of PCM system with probabilities of 1/4,1/5,1/5,1/10,1/10,1/20,1/20 and 1/20 respectively. Find the entropy and rate of information. 04

OR

Q.5 (a) Write short note on Cyclic codes. 05

(b) For a (6,3) systematic linear block code, the three parity check digits are c4 = d1+d2+d3, c5 = d1+d2, c5 = d1+d3 05

i) Construct the appropriate generator matrix for this code and code table.

ii) Determine the error correcting capability.

iii)Decode the received words 101100, 000110, 101010.

(c) Verify the following expression H(X;Y)=H(X/Y)+H(Y) 04

Q.6 (a) A source emits seven messages with probabilities 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, and 1/64, respectively. Find the entropy of the source. Obtain the compact binary code and find the average length of the code word. Determine the efficiency and the redundancy of the code. 07

(b) A binary channel matrix is given by 07

$$\begin{array}{c} \\ x_1 \\ x_2 \end{array}\begin{array}{c} \begin{array}{cc} y1 & \quad y2 \end{array} \\ \begin{bmatrix} 2/3 & 1/3 \\ 1/10 & 9/10 \end{bmatrix} \end{array} \qquad \begin{array}{l} x1, x2 = input \\ y1, y2 = output \end{array}$$

Px(x1) = 1/3 and P(x2) = 2/3. Determine H(X), H(X/Y), H(Y), H(Y/X) and I(X; Y).

OR

Q.6 (a) A source emits seven messages with probabilities 1/3, 1/3, 1/9, 1/9, 1/27, 1/27, and 1/27, respectively. Find the entropy of the source. Obtain the compact 3-ary code and find the average length of the code word. Determine the efficiency and the redundancy of the code. 07

(b) Explain Viterbi Decoding Algorithm in detail. 07

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