B.Tech Odd Semester (CBCS) Exam., December—2016

INFORMATION TECHNOLOGY

(7th Semester)

Course No. : IT–702

(Information and Coding Theory)

Full Marks : 75
Pass Marks : 30

Time : 3 hours

Note : 1. The figures in the margin indicate full marks for the questions.
2. Attempt **one** question from each Unit.
3. Begin each answer in a new page.
4. Answer parts of a question at a place.
5. Assume reasonable data wherever required.

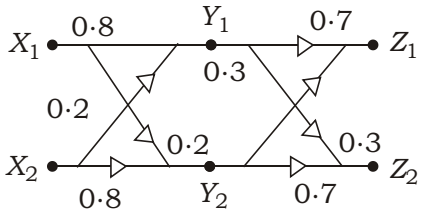
UNIT—1

1. *(a)* What is entropy? State the properties of entropy. What is information rate? Consider a telegraph source having two symbols Dot (.) and Dash (-). The Dot duration is 0·2 sec; and Dash duration is 3 times of the Dot duration. The probability of the Dots occurring is twice that of Dash and time between symbols is 0·2 seconds. Calculate information rate of the telegraph. 1+1+1+5=8

(b) What is mutual information? Prove that

$I(X; Y)$ $I(Y; X)$ 1+3=4

(c) Two BSCs are connected in cascade as shown in figure below :



(i) Find channel matrix of resultant channel.

(ii) Find $P(Z_1)$ and $P(Z_2)$, if $P(X_1)$ 0 6 and $P(X_2)$ 0 4. 3

2. A channel matrix for the ternary channel is given below :

$$\begin{matrix} 1 & 0 & 0 \\ 0 & p & 1 \quad p \\ 0 & 1 \quad p & p \end{matrix}$$

Assuming source probabilities as $P(x_1)$ P and $P(x_2)$ $P(x_3)$, determine the source

entropy $H(x)$ and the mutual information $I(X; Y)$. Also determine the channel capacity of the channel. 11+4=15

UNIT—2

3. State and prove baseband and bandpass sampling theorems for reconstruction from samples. 7+8=15

4. State and prove sampling theorem. What are the practical aspects of sampling? 10+5=15

UNIT—3

5. *(a)* What is delta modulation? Explain what is slope overload distortion. Derive an expression for a signal to quantized power for delta modulation. Assume that no slope overload distortion exists. 2+3+6=11

(b) A DM system is tested with a 10 kHz sinusoidal signal with 1 V peak to peak at the input. It is sampled at 10 times the Nyquist rate.

(i) What is the step size required to prevent slope over head?

(ii) What is the corresponding SNR? 2+2=4

6. *(a)* State adaptive modulation. What are the advantages of adaptive modulation over delta modulation? 1+2=3

(b) Consider a sine wave of frequency f_m and adaptive modulation A_m applied to delta modulator of step size . Show that the slope overload distortion will occur if

$A_m \quad / 2 \ f_m T_s$ 2

(c) Write short notes on the following : 5+5=10

(i) DPCM

(ii) ADPCM for low-bit rate speech coding

UNIT—4

7. With the help of neat diagram, illustrate BPSK transmitter and receiver. 15

8. *(a)* Derive the expression for probability of error P_e of a coherent binary ASK. 10

(b) Write a short note on M-ary modulation techniques. 5

UNIT—5

9. *(a)* For a linear block code, prove with examples that—

(i) the symbols depend on error pattern and not on transmitted codeword;

(ii) all error patterns that differ by a codeword have the same syndrome. 5

(b) The parity check matrix of a particular (7, 4) linear block code is given by

$$[H] = \begin{matrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{matrix}$$

(i) Find the generator.

(ii) List all code vectors.

(iii) What is the minimum distance between code vectors?

(iv) How many errors can be detected and how many errors can be corrected? 2+2+3+3=10

10. *(a)* Define cyclic code and its properties. Why does codeword represent to a polynomial? 2+1=3

(b) Explain generation of code vectors in systematic form and non-systematic form. 2+2=4

(c) The generator of a (7, 4) cyclic code is $G(p)$ p^3 p 1.

Find all the code vectors for the two different forms mentioned above. 4+4=8

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