



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 131601

Roll No.

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## B. Tech.

### (SEM. VI) THEORY EXAMINATION, 2014-15 DIGITAL COMMUNICATION

Time : 3 Hours]

[Total Marks : 100

Note: Attempt all questions.

1 Attempt any two questions : 2×10=20

- (a) Explain the use of scrambler and unscrambler in digital communication system. Draw the block diagram of an unscrambler using shift registers and explain its operation with suitable example.
- (b) Write short note on following digital modulation techniques :
  - (i) Differential phase shift keying (DPSK)
  - (ii) Quadrature phase shift keying (QPSK).
- (c) How FSK modulation and demodulation is done? Explain using block diagrams of modulator and demodulator.

2 Attempt any two questions 2×10=20

- (a) Write short note on following :
- (i) CDF (ii) PDF (iii) random process.
- (b) Define mean, variance and standard deviation for random variables.

Also prove the following theorem on variance

(i)  $\sigma^2 = E(X^2) - \mu^2$

(ii)  $Var(CX) = C^2 Var(X)$

(iii)  $Var(X-Y) = Var(X) + Var(Y)$

- (c) The probability density function is given as

$f_x(x) = a e^{-b|x|}$  where X is a random variable.

Find :

- (i) relationship between a and b  
 (ii) CDF  
 (iii) the probability that outcome lies between 1 and 2.

3 Attempt any two questions 2×10=20

- (a) What do you understand by matched filter and what are the properties of matched filter ?
- (b) Derive an expression for the probability of error of the binary phase shift keying (BPSK) signal.
- (c) Derive an expression for error probability of a matched filter.

4 Attempt any four questions 4×5=20

- (a) What is PN sequence? Draw suitable PN sequence generator and prove the properties of PN sequence and sketch its autocorrelation function.

- (b) With the help of block diagram and suitable expressions explain the generation and reception of direct sequence spread spectrum (DS-SS) signal using BPSK modulation.
- (c) Explain the following terms for spread spectrum system.  
 (i) Processing gain (P G)  
 (ii) Probability of error of DS/BPSK system  
 (iii) Jamming margin.
- (d) Explain the operation of frequency hop spread spectrum (FH-SS) with the help of block diagram and waveforms.
- (e) Explain how spread spectrum communication can be used for providing multipoint connectivity using CDMA techniques?

5 Attempt any five questions 5×4=20

- (a) An event has six possible outcomes with the probabilities  $p_1=1/2, p_2=1/4, p_3=1/8, p_4=1/16, p_5=1/32, p_6=1/32$ . Find the entropy of the system. Also find the information rate if there are 32 outcomes per second.
- (b) Consider a sequence of symbols emitted by a source with their probabilities as given below:

Symbol	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>
Probability	0.1	0.25	0.15	0.05	0.15	0.1	0.05	0.15

- Compute the Huffman code for the above source symbols. Also find the average codeword length and efficiency.
- (c) The generator polynomial of a (7, 4) cyclic code is  $G(p) = p^3 + p + 1$  find the code vectors for messages 0111 & 1110. If code is in systematic form.

- (d) The parity check matrix of a (7, 4) hamming code is given

$$[H] = \begin{bmatrix} 1110100 \\ 1101010 \\ 1011001 \end{bmatrix}$$

Find :

- (i) Generator matrix
  - (ii) code vector for message 1011
  - (iii) draw the encoder diagram?
- (e) The parity check matrix of a (7, 4) hamming code is given.

$$[H] = \begin{bmatrix} 1110100 \\ 1101010 \\ 1011001 \end{bmatrix}$$

Calculate the syndrome vectors for

- (i) No error in received code vector
  - (ii) Error in third bit of received code vector.
- (f) A rate 1/3 convolution encoder has generating vectors as

$$g^1 = (110), g^2 = (110) \text{ and } g^3 = (101)$$

- (i) Sketch the encoder configuration
- (ii) Draw the trellis diagram
- (iii) If input message sequence is 11010; determine the output sequence of the encoder?