F/E/TX

Reg. No: 22BEC0034

VIT
Vellore Institute of Technology

Final Assessment Test – May 2024

Course: BECE306L - Digital Communication Systems
Class NBR(s): 1165 / 1167 / 1169
Time: Three Hours
Slot: A1+TA1
Max. Marks: 100

- KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions
(10 X 10 = 100 Marks)

1. a) State and prove sampling theorem in time domain. [5]
   b) Specify the Nyquist rate and Nyquist interval for the following signal: [5]
   $x(t) = \frac{1}{2\pi}[\cos(4000\pi t)\cos(1000\pi t)]$.

2. a) Find the DPCM transmitter output of the following signal x(k) = {0.3, 1.5, 0.7, 1, 2.3, 3.7, 2.8, 3.4, 2.8, 0} by considering midtread type quantizer with step size of 1V. [5]
   b) Derive the signal-to-quantization noise ratio for PCM system. Assume that input signal is sinusoidal signal. [5]

3. a) A matched filter has a frequency response given by $H(f) = \frac{1-e^{-j2\pi fT}}{j2\pi f}$. [5]
   Determine the impulse response h(t) of the filter.
   b) How is modified duobinary coding superior compared to duobinary coding. Explain with an example. [5]

4. a) *In a binary digital communication system* binary '0' is transmitted with a waveform of voltage level 0 volts. However, alternating binary '1's' are transmitted with voltage levels 'a volts' and '–a volts' for $0 < t < T_b$. Derive the expression of power spectral density of the transmitted waveform. [5]
   b) Construct the following line codes for '10110010'. [5]
   (i) Unipolar NRZ (ii) Polar RZ (iii) AMI RZ (iv) Split phase Manchester (v) M-ary, where M=4.

5. a) What are the observations that can be made from the Eye Patterns observed on the Cathode Ray Oscilloscope (CRO)? [5]
   b) What is matched filter? Derive an expression for the transfer function of matched filter under white noise. [5]

6. A binary receiver system receives a bit rate of 1 Mbps. The waveform amplitude is 5 mV and the noise power spectral density is 0.5×10^{-11} W/Hz. Calculate the average bit error probability for ASK, BFSK, BPSK and DPSK. [10]

7.(a) Draw the signal space representation of QPSK signal showing the Euclidean distance value and sketch the modulated QPSK waveform for the input bit stream b(t) = 0110100. (Sketch all the waveforms required to obtain modulated QPSK waveform). [10]

7.(b) OR

Using Gram-Schmidt orthogonalization (GSOP) procedure, find a set of orthonormal basis functions for the signals $s_1(t)$, $s_2(t)$, $s_3(t)$ and $s_4(t)$ shown below. Also express each of these signals in terms of basis functions [10]

$S_1(t) = 2 \quad (0 \le t \le 3)$

$S_2(t) = 2 \quad (0 \le t \le 1)$

$S_3(t) = -2 \quad (1 \le t \le 3)$

$S_4(t) = 2 \quad (0 \le t \le 2)$

8. a) An analog signal bandlimited to 10 kHz is quantized in 8 levels of a 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. [5]

b) Given an AWGN channel with 4 kHz bandwidth and the noise power spectral density $\frac{\eta}{2} = 10^{-12}$ W/Hz. The signal power required at the receiver is 0.1 mW. Calculate the capacity of this channel. [5]

9. The joint probability matrix of discrete memory less channel is given below. Determine H(X), H(Y), H(X, Y), H(X/Y), H(Y/X) and I(X, Y). [10]

$$P(X, Y) = \begin{bmatrix} 0.24 & 0.06 & 0 \\ 0 & 0.4 & 0 \\ 0 & 0.09 & 0.21 \end{bmatrix}$$

10.(a) A PN sequence is generated using a feedback shift register of length 4. Find the generated output sequence if the initial contents of the shift register are 1000. If the chip rate is 10^7 chips/sec., calculate the chip, PN sequence duration and period of output sequence. Draw its scheme arrangement. [10]

OR

10.(b) Explain the principle and working of frequency hopping spread spectrum in detail. Differentiate between slow frequency hopping and fast frequency hopping. [10]

⇔⇔⇔ F/E/TX⇔⇔⇔