Q.2 a. Consider a discrete memory less source with given data. Generate a Huffman code for the same. Also show that the minimum variance Huffman code is obtained by moving the probability of a combined symbol as high as possible.

Symbol	**S_0**	**S_1**	**S_2**	**S_3**	**S_4**
Probability	**0.4**	**0.2**	**0.2**	**0.1**	**0.1**

Answer: 2.3 of Text Book.

b. Give any two properties of mutual information.

Answer: 2.5 of Text Book.

Q.3 a. Explain the following terms:
(i) Nyquist Rate **(ii) Aliasing error**
(iii) Quadrature sampling **(iv) Signal to Distortion Ratio**

Answer:
(i) 4.1 of Text Book. (ii) 4.4 of Text Book.
(iii) 4.2 of Text Book. (iv) 4.4 of Text Book.

b. Explain the sample and hold circuit for signal recovery.

Answer: Page no 160-161 of Text Book.

Q.4 a. The information in an analog signal voltage waveform is to be transmitted over a PCM system with an accuracy ± 0.1% (full scale). The analog voltage waveform has a band width of 100Hz and an amplitude range of – 10 to + 10 volts. Find the step size, No of quantization levels, minimum sampling frequency and number of bits in each PCM word.

Answer:
Accuracy = $\pm$ 0.1% , $\therefore$ Quantization error must be
$\pm$0.1% , of max Quantization error must be $\pm$0.1%
Thus $\epsilon_{max} = \pm 0.1\% = \pm 0.001$
Since max Quantization error for a uniform quantizer
i.e. $\epsilon_{max} = |\Delta/2|$

so, $\Delta = 2 \times 0.001 = 0.002$
Since step size = $2 X_{max}/q$
Where X_{max} = max. amp of signal = 10V
q = number of levels
so, $0.002 = (2 \times 10)/q$
or q = 10,000
since q = 10,000

so to find no. of bits
No. of bits $2^b = 10,000$
b = 14 bits
max freq in signal = 100Hz
f_m = 100 Hz
so fs ≥ 2fm ≥ 2 X 100 ≥ 200Hz

b. Explain Delta modulation.

Answer: 5.6 of Text Book.

Q.5 a. Explain the Nyquist criterion for distortionless baseband transmission in the absence of noise which provides a method for constructing bad limited function to overcome the effects of inter symbol interference.

Answer: 6.4 of Text Book.

b. What is Eye Pattern and how does it help to study inter symbol interference?

Answer: 6.6 of Text Book.

Q.6 a. Draw the block diagrams of a DPSK transmitter and receiver. State various advantages & disadvantages of this system of digital modulation format.

Answer: 7.4 of Text Book.

b. A binary ASK system for equally probable messages uses 100 μsec. bits and channel has $N_o = 1.338 \times 10^{-5}$ W/Hz. Determine the peak transmitted pulse amplitude to maintain $P_e \le 2.055 \times 10^{-5}$.

Given if $\mathbf{erf_c}\ \sqrt{\frac{E_b}{2N_0}} \le 2 \times 2.055 \times 10^{-5}$ **Then** $\sqrt{\frac{E_b}{2N_0}} \le 2.9$

Answer:
For ASK , $P_e = 1/2\ erf_c\ \sqrt{E_b/2N_o} < 2.055 \text{ X } 10^{-5}$

Or $\sqrt{E_b/2N_o} \ge 2.9$ or $E_b/N_o \ge 8.46$

$E_b \ge 8.46 \text{ X } 2 \text{ X } 1.338 \text{ X } 10^{-5}$

$E_b = A^2T/2$ so, $A^2T/2 \ge 8.46 \text{ X } 2 \text{ X } 1.338 \text{ X } 10^{-5}$

Also $T = 1/r_b = 100 \text{ X } 10^{-6}$ sec

Hence, $A^2 \geq 2 \text{ X } 8.46 \text{ X } 2 \text{ X } 1.338 \text{ X } 10^{-5}/100 \text{ X } 10^{-6}$

A = 4.53 volts

Q7 a. Draw detector and vector receiver diagram and explain.

Answer: Page Number 84-86 of Text Book.

b. Explain the matched filter recovers

Answer: Page Number 86-87 of Text Book.

Q8. a. A spread spectrum communication system has the following parameters
Information bit duration, T_b = 4.095 ms
PN chip duration, T_c = 1μs.
Find the processing gain, required P N sequence, feedback shift length.

If $\frac{E_b}{N_0} = 10$ **, find jamming margin.**

Answer: 9.5 of Text Book.

b. Explain the difference between slow frequency Hopping and fast frequency Hopping.

Answer: 9.6 of Text Book.

Q9 a. Write short notes on:
(i) Digital Communication by Satellite
(ii) Light Wave Transmission

Answer:
(i) Page Number 354-355 of Text Book.
(ii) Page Number 225-226 of Text Book.

Text Book

Digital Communications, Wiley Student Edition, Simon Haykin.