Subject: DIGITAL COMMUNICATIONS

Time: 3 Hours **Max. Marks: 100**

DECEMBER 2010

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. The efficiency of Huffman code is linearly proportional to

(A) Maximum length of code **(B)** Average Entropy
(C) Average length of code **(D)** Redundancy

b. Flat top sampling leads to

(A) Aliasing **(B)** Loss of signal
(C) Aperture Effect **(D)** None of these

c. In a 4-bit binary PCM system, the quantizer is of the midriser type with a step size of 1.2 volts. The quantization noise power is

(A) 0.48 Watts. **(B)** 1.44 Watts.
(C) 1.2 Watts **(D)** 0.12 Watts.

d. A computer puts out binary data at the rate of 64 Kbps. The output is transmitted using a baseband binary PAM system that is designed to have a raised cosine spectrum, with a roll off factor, $\alpha = 0.5$. The transmission bandwidth is

(A) 48 kHz **(B)** 32 kHz
(C) 64 kHz **(D)** 128 kHz

e. In a Quadrature Phase Shift Keying (QPSK) system each symbol is represented by

(A) 1 bit **(B)** 2 bits
(C) 3 bits **(D)** 4 bits

f. The early-late gate type of synchronization is used in a receiver for

(A) Bit synchronization **(B)** Symbol synchronization
(C) Carrier synchronization **(D)** None of these

g. The A-law companding scheme is used for PCM telephone systems in

(A) United States **(B)** Canada
(C) Japan **(D)** Europe

h. In a spread spectrum communication system, the information bit duration, $T_b = 2.1\times10^{-3}$ sec and PN chip duration, $T_c = 1\times10^{-6}$ sec. The processing gain of the system is

(A) 4200 **(B)** 1000
(C) 2100 **(D)** 4762

i. The complementary error function erfc(u) is defined as

(A) $\frac{2}{\sqrt{\pi}}\int_{u}^{\infty} \exp\left(-z^2\right)dz$ **(B)** $\frac{2}{\sqrt{\pi}}\int_{0}^{u} \exp\left(-z^2\right)dz$

(C) $\frac{2}{\sqrt{\pi}}\int_{0}^{\pi} \exp\left(-z\right)dz$ **(D)** $\frac{2}{\sqrt{\pi}}\int_{u}^{\infty} \exp\left(-z^2/2\right)dz$

j. Maximum length sequence used in a spread spectrum communication system satisfies balance property. Then in each period of a maximum-length sequence:

(A) The number of 1s is equal to number of 0s
(B) The number of 1s is one more than the number of 0s
(C) The number of 1s is one less than the number of 0s
(D) The number of 1s is two more than the number of 0s

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Define the following terms:
(i) Information (ii) Entropy **(4)**

b. A discrete memoryless source has an alphabet of five symbols with their probabilities for it's output as given below: **(8)**

Symbol	s_o	s_1	s_2	s_3	s_4
Probability	0.30	0.25	0.20	0.15	0.10

Calculate the average code-word length and the variance of the average code-word length over the ensemble of source symbols.

c. State and explain the channel coding theorem. **(4)**

Q.3 a. State and explain the low pass sampling theorem. Assuming a suitable spectrum for a message signal, sketch the spectrum for sampled signal for all possible cases and explain. **(8)**

b. With a neat block diagram, explain the operation of a TDM (Time Division Multiplexing) system. **(8)**

Q.4 a. Briefly, explain the working of a regenerative repeater in a PCM system. **(4)**

b. What is the necessity of non-uniform quantization? Explain the two companding methods used in practice. **(6)**

c. Define slope-overload error in delta modulation. For the sinusoidal message signal $x(t) = a_o \cos(2\pi f_o t)$ obtain the condition for no slope over load error.**(6)**

Q.5 a. What is ISI? Explain the Nyquist criterion for distortionless baseband transmission. **(6)**

b. Write a note on Eye Pattern. **(6)**

c. For the binary sequence 01101001, draw the digital format waveforms corresponding to
(i) Manchester format (ii) NRZ polar format **(4)**

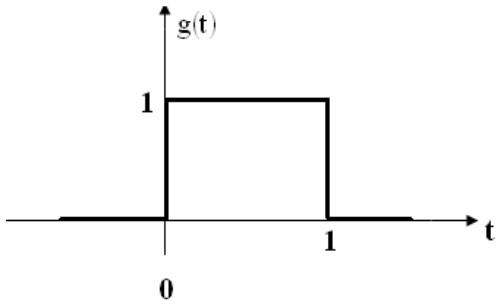
Q.6 a. For the binary data 10110111, sketch the waveforms of ASK, BPSK and FSK signals. **(6)**

b. Describe the method of generation and detection of QPSK signals with relevant block diagrams and waveforms. **(10)**

Q.7 a. Explain the Gram-Schmitt orthogonalization procedure. **(6)**

b. Write a note on correlation receiver. **(5)**

c. Let g(t) be the input of a matched filter.



Find and sketch its output. **(5)**

Q.8 a. Explain the principle of spread spectrum systems using an idealized model of a baseband system. **(6)**

b. Define the terms:
(i) Processing gain (ii) Jamming margin **(4)**

c. With the block diagrams of transmitter and receivers of a direct-sequence spread coherent binary phase-shift keying, explain the working. **(6)**

Q.9 Write short notes on:

(i) Code Division Multiple Access **(5)**
(ii) T 1 carrier system **(6)**
(iii) Diversity Techniques in digital radio **(5)**