ROLL NO. _____

Code: AE21 **Subject: DIGITAL COMMUNICATION**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **DECEMBER 2011** **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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 45 Minutes 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 Nyquist sampling rate for a signal band limited to 4 kHz is

(A) 4 kHz **(B)** 8 kHz
(C) 2 kHz **(D)** 16 kHz

b. A scheme in which '1' is represented by a +ve pulse for one half of symbol duration and a –ve pulse for remaining half of the symbol and for '0', the order is reversed is known as:

(A) NRZ UNIPOLAR **(B)** MANCHESTER
(C) NRZ BIPOLAR **(D)** NRZ POLAR FORMAT

c. For a DPSK scheme, the bit error probability is given by

(A) $\frac{1}{2}\text{erfc}\left[\sqrt{\frac{E_b}{2N_o}}\right]$ **(B)** $\frac{1}{2}\text{erfc}\left[\frac{1}{2}\sqrt{\frac{-E_b}{2N_o}}\right]$

(C) $\frac{1}{2}\text{erfc}\left[\sqrt{\frac{-E_b}{N_o}}\right]$ **(D)** $\frac{1}{2}\text{erfc}\left[\frac{1}{2}\sqrt{\frac{E_b}{N_o}}\right]$

d. The generator polynomial g(x) and parity cheque polynomial for a(n,k) cyclic code are related by

(A) $g(x) = (1+x^n).h(x)$ **(B)** $h(x) = (1+x^n).g(x)$

(C) $g(x).h(x) = (1+x^n)$ **(D)** $g(x).h(x) = \frac{1}{(1+x^n)}$

e. The key circuit used in a DPSK modulator

(A) NAND gate **(B)** XOR/XNOR gate
(C) OR gate **(D)** NOR gate

f. If the baud rate is 400 for a QPSK signal, the bit rate is_____bps.

(A) 100 **(B)** 400
(C) 800 **(D)** 1600

g. The signal to quantization noise rate in a PCM system depends upon (i) Sampling rate (ii) No of quantization level (iii) message signal bandwidth

(A) (i), (ii) and (iii) **(B)** (ii) and (iii) only
(C) (ii) only **(D)** (ii) only

h. The spectral density of white noise is

(A) exponential **(B)** Uniform
(C) Poisson **(D)** Gaussian

i. Spread spectrum modulation utilizes

(A) Wideband modulation
(B) Double modulation
(C) Direct sequence modulation
(D) Pseudo-Random sequence modulation

j. Impulse Response of a matched filter receiver is

(A) matched to signal S(t)
(B) matched to signal difference $S_2(T_b–t)$ and $S_1(T_b–t)$
(C) matched to signal difference $S_2(T_b) –S_1(T_b)$
(D) matched to sum of $S_2(T_b)+S_1(T_b)$

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

Q.2 a. What do you understand by SNR bandwidth trade off? **(6)**

b. Compare Impulse Sampling natural sampling. Consider a given waveform, x(t) with Fourier transform, X(f). Let $X_{S1}(f)$ be the spectrum of $x_{S1}(t)$, which is the result of sampling x(t) with a unit pulse train $x_\delta(t)$. Let $X_{S2}(f)$ be the spectrum of $x_{S2}(t)$, the result of sampling x(t) with a pulse train $x_p(t)$ with pulse width, T, amplitude $\frac{1}{T}$ and period, T_S. Show that in the limit, as T approaches zero, $X_{S1}(f)=X_{S2}(f)$ **(10)**

Q.3 a.

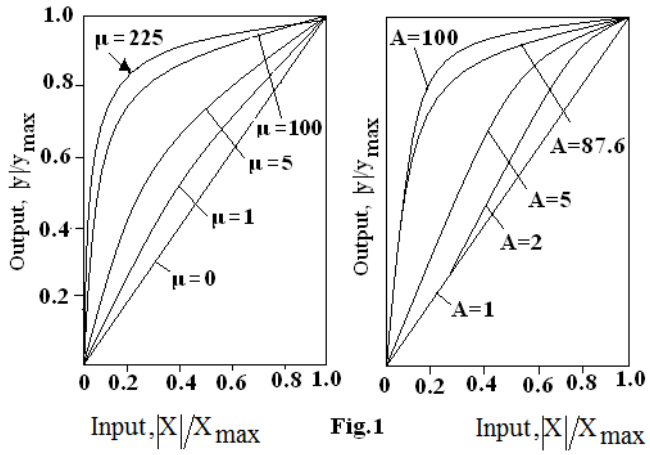

Fig.1

What are the Fig.1 representing? Make a comparison of the two and explain in detail. **(8)**

b. A waveform, $x(t)= 10\cos(1000t+\frac{\pi}{3})+20\cos(2000t+\frac{\pi}{6})$ is to be uniformly sampled for digital transmission (i) What is the maximum allowable time interval between sample values that will ensure perfect signal reproduction. (ii)If we want to reproduce 1 hour of this waveform, how many sample values need to be sorted? **(8)**

Q.4 a. In the case of baseband signalling, the received waveforms are already in a pube like form. Why then, is a demodulator needed to recover the pube waveform? **(8)**

b. A voice signal (300 to 3300 Hz) is digitized such that the quantization distortion $\leq \pm 0.1\%$ of the peak to peak signal voltage. Assume a sampling rate of 8000 samples/sec and a multilevel PAM waveform with M=64 levels. Find the theoretical minimum system bandwidth that avoids ISI (Inter Symbol Interface). **(8)**

Q.5 a. Compare QPSK and MSK digital modulation. **(8)**

b. Binary data is transmitted at a rate of 10^6 bits/sec over a channel having a BW of 3 MHz. Assume that noise PSD at the R_x is $N_o/2=10^{-10}$ W/Hz. Find the average carrier amplitude required at the R_x input for coherent PSK and DPSK signalling schemes maintain $P_e < 10^{-4}$. **(8)**

Q.6 a. What are cyclic codes? What is their importance? **(8)**

b. The generator polynomial of a(7,4) cyclic code is $g(x)=1+x+x^3$. Find the 16 code words of this code. **(8)**

Q.7 a. Draw the state diagram, tree diagram and trellis diagram for the convolutional encoder shown in the diagram (Fig.2). **(8)**

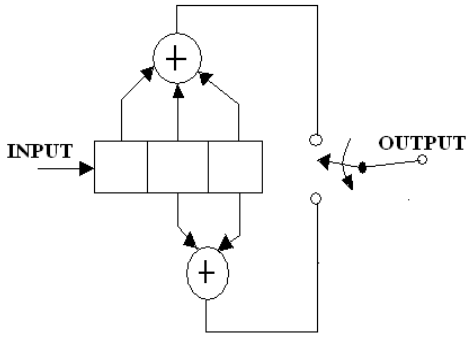

Fig. 2

b. What are the properties of convolutional codes? **(8)**

Q.8 a. Explain the principle that supports the antijam capability of spread spectrum signal. **(8)**

b. A total of 24 equal power terminals are to share a frequency band through a code division multiple access (CDMA) system. Each terminal transmits information at 9.6 Kbyte/sec with a direct sequence spread spectrum (BPSK) modulated signal. Calculate the minimum chip rate of PN code in order to maintain a bit error prob of 10^{-3}. **(8)**

Q.9 Explain any **TWO** of the following:

(i) Frequency Hopping
(ii) Extended Golay codes
(iii) Difference between coherent and non-coherent performance detection techniques regarding Bit Error performance
(iv) Turbo Codes. **(8+8)**