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**AMIETE – ET (OLD SCHEME)**


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

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      |

**Code: AE21****Subject: DIGITAL COMMUNICATIONS**

- 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  $S_2(T_b)+S_1(T_b)$

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

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- 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.

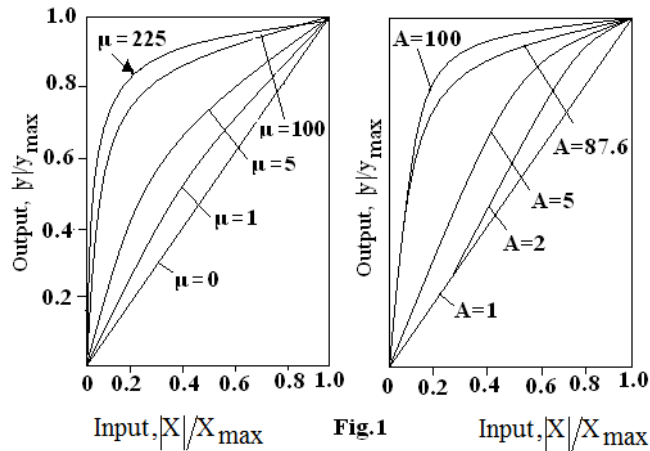


Fig.1

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 pulse like form. Why then, is a demodulator needed to recover the pulse 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  $N_0/2 = 10^{-10}$  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)

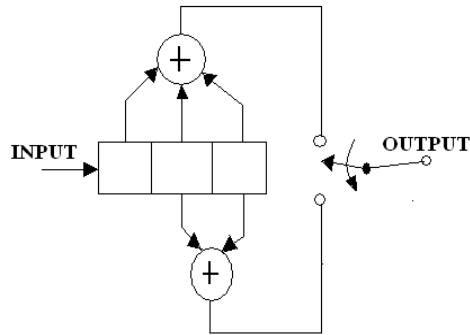


Fig. 2

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