M.E. Sem II (Rev.) Advanced Communication Theory. 24/12/08
Extx

Con. 6064-08. **BB-8345**

(REVISED COURSE)

(4 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.

1. Answer **all** the questions briefly :— **20**
   (a) State and Prove Nyquist Criterion for a band-limited channel with zero ISI.
   (b) Which are the different diversity techniques used to improve the performance of digital communication system.
   (c) Explain the working of a FHSS Transmitter and receiver, with a neat block diagram.
   (d) Find the generator matrix G, for a non-systematic (7, 4) cyclic code using generaor polynomial $g(x) = x^3 + x^2 + 1$.

2. (a) Consider a convolutional encoder having the following impulse response : **12**
   $g_1 = \{1\ 1\ 0\}$ $g_2 = \{1\ 0\ 1\}$, $g_3 = \{1, 1, 1\}$
   (i) Find the codeword for the Msg sequence (1 1 0 0 1 0 1)
   (ii) Draw its state diagram and code tree
   (iii) Find its transfer function and free-distance of this code.
   (b) Discuss Viterbi algorithm for decoding of convolutional codes. **8**

3. (a) Design a 'feedback shift-register-encoder' for an (8, 5) cyclic code with generator polynomial $g(x) = 1 + x + x^2 + x^3$. **12**
   (i) Using the encoder, find the codeword for the Msg : 1100011, in systematic form.
   (ii) Consider the codeword generated in (i) as i/p to the decoder, find the syndrome.
   (b) Consider a (9, 5) linear block code with **8**
   $p_1 = m_1 + m_2 + m_4 + m_5$
   $p_2 = m_1 + m_3 + m_4 + m_5$
   $p_3 = m_1 + m_2 + m_3 + m_5$
   $p_4 = m_1 + m_2 + m_3 + m_4$
   (i) Show the generator matrix
   (ii) Show the parity-check matrix
   (iii) Find the codewords for Msg : 10011, 11001, 11011.

4. (a) Explain decision feedback equalizer. How does it solve ISI problem ? **10**
   (b) Discuss mean-square-error criterion and explain LMS algorithm. **10**

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5. (a) Explain the working of a Preset-equalizer with a neat sketch. What are its limitations ? **8**

   (b) Binary PAM is used to transmit information over an unequalized linear filter channel. When a = 1 is transmitted, the noise-free output of the demodulator is : **12**

$$x_m = \begin{cases} 0{\cdot}25 & m = 1 \\ 0{\cdot}9 & m = 0 \\ 0{\cdot}25 & m = -1 \\ -0{\cdot}1 & m = -2 \\ 0 & \text{otherwise} \end{cases}$$

   (i) Design a 3-tap zero forcing linear equalizer so that the output is

$$q_m = \begin{cases} 1 & m = 0 \\ 0 & m = \pm 1 \end{cases}$$

   (ii) Determine q_m for $m = \pm 2, \pm 3$, and find the residual ISI.

6. (a) Explain how the time-synchronization of receiver spread spectrum signal may be achieved. **10**

   (b) (i) Define the following : Frequency-selective channel, Frequency-non-selective channel, slowly-fading channel, Doppler frequency spread of the channel. **5**

   (ii) A shortwave ionospheric radio channel is characterised by a multipath spread of T_m = 5ms and a Doppler spread of B_d = 0·1 Hz. (a) Determine the coherence bandwidth and coherence time of the channel. (b) A signal transmitted over this channel has a bandwidth of W = 50 Hz and a time duration of 20 Ms. Is this a frequency selective channel ? Is the channel slowly fading ? Justify your answer. **5**

7. Write short notes on : (any **four**) :— **20**

   (a) Convergence properties of LMS algorithm
   (b) Tapped-delay line channel Model
   (c) Synchronization in FHSS
   (d) Trelis coded modulation
   (e) FFT-based multicarrier system.