M-E (ETRX) Sem II (R)
Advanced Communication Theory

Con. 5073-09. BB–6167

(4 Hours) [Total Marks : 100

31/12/09
10.30 to 2.30

N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt **five** questions including the **Compulsory** question.
(3) Assume suitable data if **necessary**.

1. (a) In case of cyclic code, state the conditions to be satisfied for a valid generator polynomial. Hence, obtain a valid generator polynomial for a(7, 4) cyclic code. **5**
   (b) Distinguish between hard decision decoding and soft decision decoding. **5**
   (c) Derive and sketch the magnitude spectrum of a duobinary signal pulse. **5**
   (d) Describe diversity combining techniques. **5**

2. (a) Consider a systematic block code whose parity check bits are given by— **10**

$$P_1 = m_1 + m_2 + m_4$$
$$P_2 = m_1 + m_3 + m_4$$
$$P_3 = m_1 + m_2 + m_3$$
$$p_4 = m_2 + m_3 + m_4$$

   (i) Find the generator matrix and parity check matrix for the code.
   (ii) Find the error detecting and error correcting capabilities of the code.
   (iii) Sketch the encoder realisation.

   (b) For a (7, 4) cyclic code with generator polynomial $g(x) = x^3 + x + 1$, **10**
   (i) Sketch shift register implementations for encoder and syndrome calculator.
   (ii) For the message {1010}, find the codeword using the above encoder. Verify by calculation.
   (iii) For the received codeword { 1001010 }, find the syndrome using the syndrome calculator in (1). Verify by calculation.

3. (a) A Convolution code is described by — **12**

$g_1 = \{ 110 \}$, $g_2 = \{101\}$, $g_3 = \{1 \cdot 11\}$

   (i) Sketch the encoder and find the codeword for the message { 10011101}
   (ii) Sketch the state transition diagram.
   (iii) Find the transfer function and free distance for this code.

   (b) Explain Viterbi algorithm for decoding of convolutional code with an example. **8**

4. (a) State and prove Nyquist Criterion for a bandlimited channel with zero ISI. **10**
   (b) Derive and plot the impulse response of the ideal Nyquist Channel. Hence, justfy the statement."For an ideal Nyquist Channel, the sum of the resulting ISI does not converge." **10**

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5. (a) The unequalised pulse in a PAM system has the following values at sampling times. 12

$$X_m = \begin{cases} 0 & m = -2 \\ 0{\cdot}1 & m = -1 \\ 1{\cdot}0 & m = 0 \\ -0{\cdot}2 & m = +1 \\ 0{\cdot}1 & m = +2 \\ 0 & \text{Otherwise} \end{cases}$$

(i) Design a three top zero forcing equalizer.

(ii) For the coefficients determined in (1), obtain the equalizer output for $m = \pm 2, \pm 3$. Hence, determine the residual ISI and its span in time.

(b) With a neat sketch, explain the working of preset equalizer. 8

6. (a) Explain LMS algorithm. Explain the effect of steps size on the following parameters : Convergence rate, excess mean square error and lag error. 10

(b) Explain with a neat sketch, the working of decision feedback, equalizer. Obtain equation for coefficients of feed for word and feedback filter. 10

7. Write detailed notes on any **two** :— 20

(a) Trellis-coded modulation

(b) Slow and fast frequency hopping

(c) Multi-carrier system.
