Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(ECE-COMM)/SEM-2/MCE-202/2012

2012
ERROR CONTROL CODING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

Answer any *five* questions : 5 × 2 = 10

1. i) Define systematic block code with an example.

   ii) Find the code rate of Hamming code with an example.

   iii) Compare ARQ & FEC schemes of error control strategies.

   iv) Find the memory order of an encoder for a (4,3,2) convolution code.

   v) State Shannon's fundamental theorem for a noisy channel.

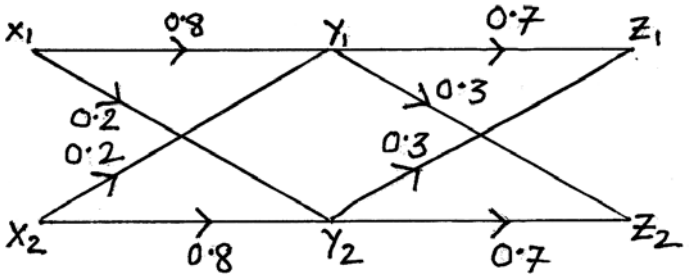
   vi) Explain irreducible polynomial with an example.

   vii) Show that the code C = {000, 100, 011, 111} is not cyclic.

GROUP – B

Answer any *five* questions : 5 × 12 = 60

2. a) Two binary symmetrie channels are connected in cascade as shown in figure.



i) Find the channel matrix of the resultant channel. Draw the channel diagram.

ii) Find $P(z_1)$ and $P(z_2)$ if $P(x_1) = 0.6$ and $P(x_2) = 0.4$

4 + 3

b) Explain with an example how the error probability decreases with repetition code in binary communication. 5

3. a) What do you mean by Galois Field (GF) ? Give example.

4

b) A memoryless source emits symbols m_1 and m_2 with probabilities 0.8 and 0.2 respectively. Find the binary optimum code for this source. Compare the performance of this code with its second binary extension. 8

4. The parity check matrix of a particular (7, 4) linear block code is given by

$$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

a) Find generator matrix, G.

b) List all the code vectors.

c) Design the encoder for this code. 4 + 5 + 3

5. a) Explain the error detection and correction capabilities of Hamming code. 3

b) What is standard array ? Explain how the standard array can be used to make a correct decoding. 2 + 3

c) Consider the parity check matrix

$$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$ and a transmitted code vector X = 0100110. The received code vector Y is obtained assuming the 3rd bit in error. Show how syndrome is used for this error correction. 4

6. a) C be a (7,4) cyclic code with $g(x) = 1 + x + x^3$. Find a generator matrix G for C and find code word for d = (1010). 3 + 2

b) Explain dual cyclic code with an example. 7

7. a) Explain the difference between linear block code with convolution code. 4

b) A convolution encoder has the following two generator sequences each of length 3.

1. Input-top adder-output path :

$(g_0^{(1)}, g_1^{(1)}, g_2^{(1)}) = (1,1,1)$

2. Input-bottom adder-output path:

$(g_0^{(2)}, g_1^{(2)}, g_2^{(2)}) = (1,0,1)$

Consider the incoming message sequence be as follows :
$(m_0, m_1, m_2, m_3, m_4) = (10011)$

Determine the output encoded sequence. 8

8. Write short notes on any *two* of the following : 6 + 6

a) Arithmetic code

b) Meggitt decoder

c) Reed-Solomon code

d) Golay code.