(vi) Common decoding technique for convolution code word is known as
(a) Syndrome decoding (b) Hamming decoding
(c) Viterbi decoding (d) Huffman decoding

(vii) For very large message sequence the code rate of the convolution depends upon
(a) shift register size
(b) number of modulo-2 adders
(c) number of bits of message sequence
(d) initial stage of shift register

(viii) According to Shannon channel capacity theorem, channel capacity C is given by
(a) $\log_2(1+P/N_0B)$ bits/s (b) $B.\log_2(1+P/N_0B)$ bits/s
(c) $B.\log_2(B+P/N_0)$ bits/s (d) $\log_2(1+PN_0/B)$ bits/s

(ix) Modulo-2 addition of two polynomials $C_1(X)=1+X+X^2$ and $C_2(X)=1+X_2$ is given by
(a) 1 (b) X (c) X^2 (d) $1+X^2$

(x) Convolutional codes can be decoded by
(a) Shannon Fano algorithm (b) Barlekamp Massey algorithm
(c) Viterbi algorithm (d) Set Partitioning technique

Group - B

2. (a) Why Huffman code is called optimum code?A DMS has five symbols x_1,x_2,x_3,x_4,x_5 with $p(x_1)=0.4$, $p(x_2)=0.19$, $p(x_3)=0.16$, $p(x_4)=0.15$, $p(x_5)=0.1$.Construct a Shanon Fano code and calculate the code efficiency.

(b) State and explain Source coding theorem. Define and briefly explain the term Channel Capacity for a BSC.

(1 + 5) + (3 + 3) = 12

3. (a) State and illustrate the modulo-p addition and modulo-p multiplication for finite field GF(7).

(b) What is Galois field? Construct the Galois field **$GF(2^5)$** generated by $p(x) = x^5+ x^2 +1$ and show the binary representation of elements (consider upto 16 elements).

6 + 6 = 12

Group - C

4. (a) A (7, 4) linear cyclic code has a generator polynomial $g(x) =1+x+x^3$. Draw the syndrome circuit.

(b) Find out the syndrome showing all the contents of the registers in all the required shifts for r = 0010110

6 + 6 = 12

5. (a) Explain the following terms applicable to Linear Block Coding
(i) generator matrix
(ii) syndrome
(iii) Hamming distance and Hamming weight

(b) The P matrix of a (7,3) linear block code is given by

$$P = \begin{bmatrix} 1100 \\ 0110 \\ 1111 \end{bmatrix}$$

Find out the block code words for 3 bits data words. What is the minimum Hamming distance in this case?
How many errors are correctable here?

6 + 6 = 12

Group - D

6. (a) Construct a single error correcting Reed-Solomon code with blocklength 7.Consider a (7, 5) Reed –Solomon code with generator polynomial $g(x) = x^2 + \alpha^4x +\alpha^3$ and construct the systematic codeword for the information word $i = (10, \alpha, \alpha^5, \alpha^2)$.

(b) Write a short note on Barlekamp algorithm.

6 + 6 = 12

7. (a) A convolutional encoder has a two stage phase shifter, two modulo-2 adders and a multiplexer. Draw the block diagram of the convolutional encoder using these units.What is the value of constraint length and code rate for the encoder?

(b) If a message sequence 11101 is applied at the input what will be the output? What is the justification of calling this encoder a convolutional encoder?

6 + 6 = 12

Group - E

8. (a) Draw a labelled block diagram of Trellis Coded Modulation (TCM) encoder. Explain its operation. What is the advantage of TCM encoding over channel coding and modulation executed separately?

   (b) What is Set Partitioning technique as followed in TCM? Illustrate set partitioning procedure for an 8PSK signal set.

8 + 4 = 12

9. (a) What is the significant advantage of Turbo codes over other channel codes? Draw a labelled block diagram of a Turbo encoder and explain its various operational aspects.

   (b) Describe Maximum Likelihood Decoding (MLD) method for decoding of Turbo codes.

7+ 5 = 12

2016

ERROR CONTROL & CODING
(ECEN 5202)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following: **10 × 1=10**

   (i) Memoryless channels are called
   (a) burst error channels (b) random error channels
   (c) combined error channels (d) none of these

   (ii) If linear block code is an error correcting code then it must atleast
   (a) satisfy the hamming bound
   (b) over satisfy the hamming bound
   (c) dissatisfy the hamming bound
   (d) none of theses

   (iii) To design an error correcting LBC with 8 bits of message block the minimum number of bits in the codewords should be
   (a) 15 (b) 11 (c) 12 (d) 16

   (iv) The entropy of a binary memoryless source is maximum when any of the binary symbols has a probability p equal to
   (a) zero (b) 0.2 (c) 0.5 (d) 0.7

   (v) "The hamming distance between two n-tuples V and W is equal to the hamming weight of the sum of V&W". This statement is
   (a) true (b) false
   (c) not a property of LBC (d) none of theses