Master of Electronics & Telecommunication Engineering Examination, 2019
1st Year 2nd Semester
Coding Theory

Time: Three hours | Full Marks: 100

Answer any ten questions
All questions carry equal marks
Answer all the parts of a question in the same place

1. a) Explain different error control techniques. (3)
   b) What do you mean by Field? Write required conditions for a Field. Define finite Field and give an example. (1+3+3)

2. a) What is Hamming distance ? Write the relationship between minimum distance and error detecting and correcting capability. (4)
   b) What do you mean by repetition code? A (7, 1) repetition code used to encode information sent through a channel with a bit error probability of 0·01. Find the probability that an information bit will be received erroneously after coding. (2+4)

3. a) For a systematic (7,4) cyclic code determine the parity check matrix if generator polynomial $g(x) = 1+x+x^3$. (4)
   b) Let the polynomial $g(x) = x^{10}+ x^8+ x^5+ x^4 + x^2+ x+ 1$ be the generator polynomial of a binary cyclic code with block length 15. How many errors can this code detect and correct? Find the generator polynomial of its dual code. (2+4)

4. a) If the generator matrix G of a (7, 4) Hamming code is

$$G = \begin{matrix} 1\,0\,1\,1\,1\,0\,0 \\ 0\,1\,1\,0\,1\,0\,0 \\ 0\,0\,1\,1\,0\,1\,0 \\ 0\,0\,0\,1\,1\,0\,1 \end{matrix}$$

   then determine the systematic codeword for the message $m = [1\ 0\ 0\ 1]$. (4)
   b) What do you mean by shortened and extended linear codes? (2)
   c) A (15, 5) linear cyclic code has a generator polynomial has $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + X^{10}$. Find the code polynomial for the message polynomial $d(x) = 1+ x^2 + x^4$ (in a nonsystematic form). (4)

5. a) What do you mean by primitive polynomial? (2)
   b) A is an element of $GF(2^4)$ and 4-tuple representations of A is $(a_3\ a_2\ a_1\ a_0)$. Derive a simplified expression for A^2. (3)
   c) What do you mean by conjugates in finite Field? Determine the conjugates of α^3 in $GF(2^3)$ and in $GF(2^4)$. (1+4)

6. a) If $r(x) = x^{11}+x^{10}+x^8+x^7+x^6+x^3$ is a received codeword polynomial of a double error correcting BCH code over $GF(2^4)$, then determine syndromes, where the field is defined by the primitive polynomial $p(x) = x^4+x+1$
   b) Write the main steps of the Peterson-Gorenstein-Zierler decoder.

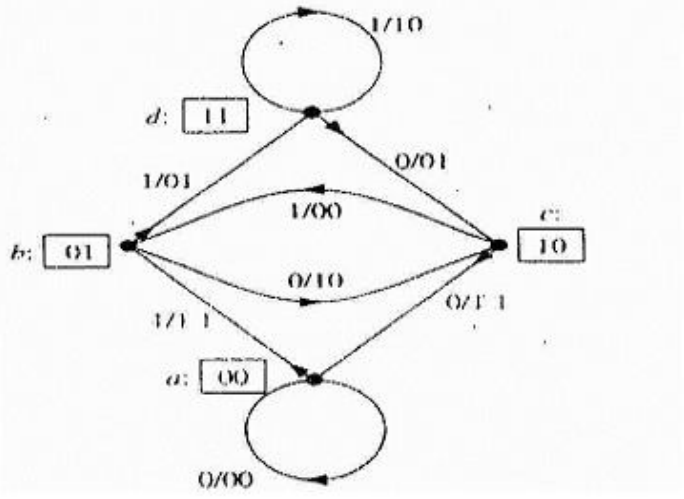
(5+5)

7. a) Prove that the syndrome polynomial in a cyclic code solely depends on error polynomial. (2)
   b) Write the Singleton bound and define maximum distance separable code. (2)
   c) Derive the relationship between syndromes and error location numbers of a t-error correcting RS Codes. Explain the working principle of Chien search algorithm.

(4+2)

8. a) Explain the concept of Maximum Likelihood decoding. (2)
   b) For the state transition diagram of a convolutional encoder shown below suppose the first eight received bits are 01101100. Explain the process of decoding using Viterbi's algorithm.

(8)



9. a) State the necessary and sufficient condition for the generation of maximal length sequence (m-sequence). (2)

b) Which factor does the characteristic polynomial of the Linear Feedback Shift Register (LFSR) depend upon? State its impact on the performance of the sequence. (2)

c) How does the initial condition vector influence the sequence? (1)

d) Generate an m-sequence of length 7 using the Multiple Return Shift Register Generator (MMSRG). (5)

10. State the conditions to be satisfied to have a preferred pair of m-sequences. Hence show that two m-sequences a = 1110010 and a' = 1110100 form a preferred pair of m-sequences. (3+7)

11.a) Consider that C_N is a matrix of size NxN and denotes a set of N number of binary spreading codes of chip rate N. Develop a structure to generate variable length orthogonal codes corresponding to N = 4. (6)

b) List down your observations on the above structure regarding the orthogonality of the generated codes. (4)

12. How will you represent Walsh Hadamard code of length 8 based on concatenation? How the approach of permutation would modify the Walsh Hadamard code? (4+6)