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END SEMESTER EXAMINATION-2015

M.Tech II Semester, ECE

COURSE CODE: 10M11EC213 MAX. MARKS: 45

COURSE NAME: INFORMATION AND CODING THEORY

COURSE CREDITS: 03 MAX. TIME: 3 HRS

Note: All questions are compulsory. Answer all questions in any section in one place. A partial table of GF(2^4) based on $D^4 + D + 1$ is given at the end of the paper for your use if required

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Section A **(1 x9 = 9 marks)**

1. An experiment has 10 elements in its sample space, $x_1, x_2 \ldots\ldots x_{10}$ with probabilities $p_1, p_2 \ldots\ldots p_{10}$ (which are in increasing order). The probability of x_4 is changed to $p_4 + \Delta$ and the probability of x_9 is changed to $p_9 - \Delta$. What happens to the entropy?

2. A set of symbols are coded in ternary format, using Huffman coding. If the number of symbols is 15 how many should be combined in the first step?

3. The weighted sum of four convex ∩ functions will also be a convex ∩. True or false? Justify your answer.

4. The set of polynomials with coefficients 0,1 has addition and multiplication defined in the usual way Is the system a Field? Explain.

5. Are Hamming codes sphere pact codes? Explain

6. Explain why any irreducible polynomial of degree more than 1, over GF(2) must have an odd number of terms?

7. Minimum weight of a Block code is 5. How many errors can it detect? How many errors can it correct?

8. A codeword, given by $\sum_{i=0}^{7} x_i D^i$ is cyclically shifted by two steps. What will be the new code?

9. A binary convolutional code is based on the polynomials 1+D and $1+D^3$. Is this code catastrophic?

Section B **(3 x4.5 = 13.5 marks)**

10. Describe the LZW scheme for source coding. In particular explain how the receiver can decode a received character which is not in its dictionary. Compare its advantages and disadvantages viz-a-viz Huffman coding.

11. Explain threshold decoding. Describe the threshold decoder for the (2, 1, 6) convolutional coder with $x_j = m_j$ and $x_j' = m_j + m_{j-2} + m_{j-5} + m_{j-6}$.

12. If α is a primitive element of GF(2^4), determine the order of α^3 . Discuss the procedure to be used.

Section C **(5 x4.5 = 22.5 marks)**

13. For a DMC with fixed transition probability, show that the mutual information I (X; Y) is a convex ∩ function of the input probability assignment?

14. A (2, 1, 2) convolutional code is based on the function $x_j = m_j$ and $x_j' = m_j + m_{j-1} + m_{j-2}$. For this code determine the output when the input message stream is 11001010…. Also draw the state diagram for this coder. Calculate the minimum free distance for this code?

15. Draw the block diagram for the multiplication of the field elements a(t) and b(t) in the field of polynomials based on $D^4 + D + 1$. Explain how it works.

16. Describe how the parity check code may be decoded. Given the parity check code matrix, how can you create the syndrome decoding table?

17. What are the BCH codes? Design a BCH code based on GF(2^4). This code should be able to detect all 1 bit errors.

Table of field based on $D^4 + D + 1$		
Element	α(t)	Minimal Function
0	0 0 0 0	
1	0 0 0 1	D+1
α	0 0 1 0	$D^4 + D + 1$
α^2		
α^3		$D^4 + D^3 + D^2 + D + 1$
α^4	0 0 1 1	
α^5		$D^2 + D + 1$
α^6		
α^7	1 0 1 1	
α^8	0 1 0 1	
α^9		
α^{10}	0 1 1 1	
α^{11}		
α^{12}	1 1 1 1	
α^{13}	1 1 0 1	
α^{14}	1 0 0 1	