EE 605: Error Correcting Codes

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Quiz 3 : **10 points** **Duration**: 60 minutes

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1. (a) Using the field $\mathbb{F}_{16}$ generated by the primitive polynomial $p(X) = X^4 + X^3 + 1$, determine the generator polynomial of the double error correcting binary BCH code of length 15. The power and remainder representations of the field elements in $\mathbb{F}_{16}$ in terms of a primitive element α are given below. [3 points]

0	0
1	1
α	α
α^2	α^2
α^3	α^3
α^4	$\alpha^3 + 1$
α^5	$\alpha^3 + \alpha + 1$
α^6	$\alpha^3 + \alpha^2 + \alpha + 1$
α^7	$\alpha^2 + \alpha + 1$
α^8	$\alpha^3 + \alpha^2 + \alpha$
α^9	$\alpha^2 + 1$
α^{10}	$\alpha^3 + \alpha$
α^{11}	$\alpha^3 + \alpha^2 + 1$
α^{12}	$\alpha + 1$
α^{13}	$\alpha^2 + \alpha$
α^{14}	$\alpha^3 + \alpha^2$

   (b) Suppose for the BCH code described above the error locator polynomial found by the Berlekamp-Massey algorithm is $\sigma(X) = 1 + \alpha^{10}X + \alpha^{12}X^2$. If the all zeros codeword was sent, determine a received vector $\mathbf{r} = \begin{bmatrix} r_0 & r_1 & \cdots & r_{n-1} \end{bmatrix}$ which results in this error locator polynomial. [3 points]

2. Determine the generator polynomial of a double error correcting Reed-Solomon code with symbols from $\mathbb{F}_{16}$. Assume a primitive element α for $\mathbb{F}_{16}$ whose minimal polynomial is $p(X) = X^4 + X^3 + 1$ (you can use the table above for calculations involving α). What is the codeword corresponding to the following information bits? [4 points]

$$\mathbf{u} = \begin{bmatrix} 0001 & 0001 & 0000 & 0000 & \cdots & 0000 \end{bmatrix}$$