資工系 **Error Control Coding** 小考 **99. 12.29 (open book)**

1. (35%) Consider the (15,5) cyclic code generated by the following polynomial:

$$g(x) = 1+x+x^2+x^4+x^5+x^8+x^{10}$$

This code has been proved to be capable of correcting any combination of three or fewer errors. Suppose that this code is to be decoded by the simple error-trapping decoding scheme.

(a) (5%) Show how to construct g(x)?

(b) (5%) Find all zeros of g(x) ?

(c) (10%) Suppose the input information polynomial $i(x)=1+x^3$, the error pattern polynomial $e(x)= x^2+x^9$, find the codeword polynomial c(x) and the received polynomial r(x)?

(d) (15%) Devise a Peterson-Gorenstein-Zierler decoder for this code.

2. (30%)Consider the Galois field $GF(2^4)$. The element $\beta = \alpha^7$ is also a primitive element. Let $g_0(x)$ be the lowest-degree polynomial over GF(2) which has

$$\beta, \beta^2, \beta^3, \beta^4$$

as its roots. This polynomial also generates a double-error-correcting primitive BCH code of length 15.

(a) (10%) Determine $g_0(x)$.

(b) (10%) Find the parity-check matrix for this code.

(c) (10%) Show that $g_0(x)$. is the reciprocal polynomial of the polynomial g(x) which generates the (15, 7) double-error-correcting BCH code given in page 2 of the BCH_code handout.

3. (35%) Consider the Galois field $GF(4^2)$.

Find a (15,9) double-error-correcting BCH code over GF(4).

(a) (5%) g(x) = ? (take $j_0 = 1$)

(b) (5%) Which roots does the g(x) have over $GF(4^2)$?

(c) (10%) Suppose the input information polynomial $i(x)=2+3x^4$, the error pattern polynomial $e(x)= 3x^2$. Find the codeword polynomial c(x) and the received polynomial r(x)?

(d) (15%) Devise a Peterson-Gorenstein-Zierler decoder for this code.