# ECE/CS 4434/6434
# Class Activity 4

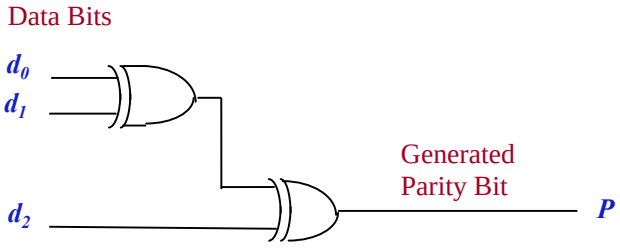
## Group Submissions Due Monday, October 7 in Class
## Online Students: Email Submission to me and TAs by October 7, 11:59pm

Write your names and UVa Email IDs here:

_____William Loving (wfl9zy) _____

_____

**Problem 1** – The data packet d = (*d2, d1, d0*) is encoded using the following circuit before transmission on the network and the codeword c = (*d2, d1, d0, P*) is generated:




Parity Bit = 0

Determine the codeword that will be generated for data packet d = (1, 1, 0): C = ( 1, 1 ,0 ,0 )

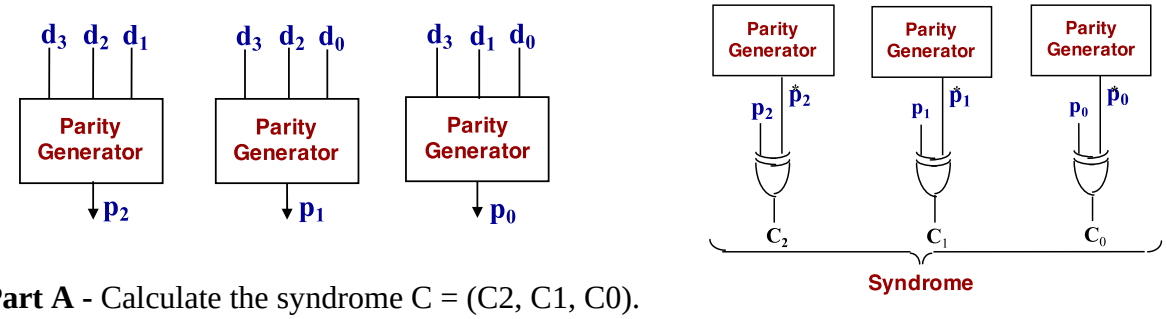
What is the code distance of this parity encoding scheme? How many single bit-errors can be detected or corrected using this scheme?

Code Distance = ____2_____ Detect = ___1_____ Correct = _____0____

**Names: _William Loving_____**

**Email IDs: _____wfl9zy_____**

**Problem 2 –** The data packet d = (*d3, d2, d1, d0*) = (1, 1, 0, 1) is encoded using the following Hamming code circuit and the codeword c = (*d3, d2, d1, d0, p2, p1, p0*) is generated and transmitted on the network. The parity checking circuit at destination generates the parity vector on the received codeword p* = (*p*2, p*1, p*0*) = (1, 0, 1).




**Part A -** Calculate the syndrome C = (C2, C1, C0).

Assumed Even Bit Parity

$p_2 = 0$
$p_1 = 1$
$p_0 = 0$
$C2 = p_2 \oplus p_2^* = 1 \oplus 0 = 1$
$C1 = p_1 \oplus p_1^* = 0 \oplus 1 = 1$
$C0 = p_0 \oplus p_0^* = 0 \oplus 1 = 1$
Syndrome $C = (1,1,1)$

**Part B -** Determine which bit is in error and explain why.

$111_2 = 7_{10}$, The 7th bit is in error as the syndrome in base 10 points to the index of the incorrect bit.

**Problem 3** – Consider a (5, 4) cyclic code with the generator polynomial G(X) = X + 1. For each of the following parts, provide an answer in the space provided. Show your work and a justification for your answer to get partial credit.

**Part A -** For data word $D_1(X)$ = (0110), we obtain the codeword $C_1(X)$ = **1010**

$D_1(X) = X^2 + X$
$G(X) = X + 1$
$C_1(X) = X^2 + X\ (X + 1)$
$C_1(X) = X^3 + 2X^2 + X$
$C_1(X) = X^3 + X$
$C_1(X) = 1010$

**Names: _William Loving_____**

**Email IDs: _____wfl9zy_____**

**Part B -** The codeword $C_2(X) = X^4+X$ is received with no error, the corresponding data word was $D_2(X) = X^3 - X^2 + X$

$$C_2(X) = D_2(X)G(X)$$
$$X^4 + X = D_2(X)(X + 1)$$
$$D_2(X) = \frac{(X^4 + X)}{X + 1}$$
$$D_2(X) = X^3 - X^2 + X$$

**Part C -** The codeword $C_3(X) = X^4+X^3+X^2+X+1$ is received, is an error detected or not?

Yes, a remainder of 1 is left behind so there is an error detected.

**Hint:** Remember that a cyclic code (n, k) encodes data into codewords of length *n*, by multiplying *k*-bit data word by a *n-k* degree polynomial.