# Problem 1

Determine the value of the following determinant over GF(4) $\det\begin{bmatrix} 2 & 1 & 2 \\ 1 & 3 & 2 \\ 1 & 0 & 1 \end{bmatrix} = ?$

## Problem 2

Perform the operation $x = 4 \cdot 7$ over $GF(8)$ with the help of shift registers if the irreducible polynomial is $P(y) = y^3 + y + 1$

# Problem 3

Given a cyclic RS code over GF(8) correcting every double errors.
Give the parameters of the code.
Give the parity check polynomial in the standard form

**Help for the arithmetic (the power table over $GF(2^3)$):**

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 7 | 14 | 21 |
| $y$ | $y$ | 8 | 15 | 22 |
| $y^2$ | $y^2$ | 9 | 16 | 23 |
| $y+1$ | $y^3$ | 10 | 17 | 24 |
| $y^2+y$ | $y^4$ | 11 | 18 | 25 |
| $y^2+y+1$ | $y^5$ | 12 | 19 | 26 |
| $y^2+1$ | $y^6$ | 13 | 20 | 27 |

# Problem 4

Given a cyclic RS code over GF(8).

a.) What are the parameters of the code ($n,k$) if two errors are to be corrected.

b.) Give the parity check polynomials (the power primitive element $y$ are used as roots)

c.) What is the received vector if the corresponding polynomial is
$$v(x) = y^5x^6 + y^5x^5 + y^5x^4 + y^5x^3 + y^5x^2 + y^5x^1 + y^5$$

d.) What is the degree of the generator polynomial of the code and what is the coefficient of its largest power?

## Problem 5

Give the generator polynomial of the cyclic RS code capable of correcting every single error!

## Problem 6

Given a cyclic code over GF(8) with the generator polynomial:   $g(x) = x^3 + y^6 x^2 + yx + y^6$

a) What are the code parameters?

b) Give the code word belonging to the message vector. The components of the code word are all 1-s in binary form (the code word is supposed to be given also in binary form)

c) Can this code be an RS code?

# Problem 7

We have a cyclic RS code with parameters C(7,2)

a)  Give the appropriate field parameter $GF(p)$

b)  How many errors can we detect and correct with this code?

c)  Give the generator polynomial $g(x)$

d)  Give the parity check polynomial $h(x)$

e)  We observe a received vector represented in the decimal form $\mathbf{v} = (0,1,4,3,5,6,2)$ can this be a codeword?

f)  We observe a received vector represented in the decimal form $\mathbf{v} = (0,1,4,2,5,6,2)$ what is the detected error vector?