NANYANG TECHNOLOGICAL UNIVERSITY
School of Electrical and Electronic Engineering

E6101 DIGITAL COMMUNICATIONS

Tutorial 1

1. Determine which, if any, of the following polynomials can generate a cyclic code with codeword length $n \leq 7$. Find the (n, k) values of any such codes that can be generated.
(**a**) $1 + X^3 + X^4$
(**b**) $1 + X^2 + X^4$
(**c**) $1 + X^3 + X^5$

2. Consider a (7, 4) code whose generator matrix is

$$\mathbf{G} = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

(**a**) Find all the code vectors of the code.
(**b**) Find **H**, the parity-check matrix of the code.
(**c**) Compute the syndrome for the received vector 1 1 0 1 1 0 1. Is this a valid code vector?
(**d**) What is the error-correcting capability of the code?
(**e**) What is the error-detecting capability of the code?

3. Consider the linear block code with the codeword defined by

$\mathbf{U} = m_1{+}m_2{+}m_4{+}m_5,\ m_1{+}m_3{+}m_4{+}m_5,\ m_1{+}m_2{+}m_3{+}m_5,\ m_1{+}m_2{+}m_3{+}m_4,\ m_1,\ m_2,\ m_3,\ m_4,\ m_5$

(**a**) Show the generator matrix.
(**b**) Show the parity-check matrix.
(**c**) Find n, k, and $d_{\min}$.

4. Design a feedback shift register encoder for an (8, 5) cyclic code with a generator $\mathbf{g}(x) = 1 + X + X^2 + X^3$. Use the encoder to find the codeword for the message 1 0 1 0 1 in systematic form.