Cyclic Codes

Information Theory Exercises

1. Find the non-systematic and then the systematic cyclic codeword for the sequence $\mathbf{i} = [1010001100]$, considering a cyclic code with generator polynomial $g(x) = 1 \oplus x \oplus x^3$.
   a. Do it "the mathematical way" (with polynomials)
   b. Do it "the programming way" (XOR-ing bit sequences)

2. We receive a sequence $\mathbf{r} = 101011100101$, which was encoded with a systematic cyclic code with generator polynomial $g(x) = 1 \oplus x^2 \oplus x^3$. Find if there are errors in the received data, and, if yes, perform correction and retrieve the transmitted information bits.
   a. Do it "the mathematical way" (with polynomials)
   b. Do it "the programming way" (XOR-ing bit sequences)

3. We do cyclic coding on information words of length $k = 8$ bits. We want the coding rate R to be at most 0.6. What degree must the generator polynomial $g(x)$ have?