Sol. 6

```
110011 ) 111100001100000
         110011
         ·010111
         000000
          101111
          110011
           111000
           110011
            010110
            000000
             101100
             110010
              111110
              110011
               011010
               000000
                11010
```

Remainder ⇒ CRC value = 11010

Sol. 7

(a) $P(x) = x^4 + x + 1 \quad (10011)$

Given bits $\Rightarrow$ 100100110110000

$\Rightarrow x^{14} + x^{11} + x^8 + x^7 + x^5 + x^4$

```
                1000101010100
        ┌──────────────────────────
  10011 │  100100110110000
            10011
            00010
            00000
             00101
             00000
              01011
              00000
               10110
               10011
                01011
                00000
                 10111
                 10011
                  01000
                  00000
                   10000
                   10011
                    00110
                    00000
                     01100
                     00000
                      (1100)
```

CRC value → 1100

(b) Error Pattern: 100010000000000

Code word: 100100110111100

After flipping bits at position 1 & 5

Received list: 000110110111100

```
            0001100 1110
10011 ) 0001 10 110111100
        00000
          00110
          00000
           01101
           00000
            11011
            10011
             10000
             10011
              00111
              00000
               11111
               10011
                11001
                10011
                 11001
                 10011
                  10100
                  10011
                   01110
                   00000
                    01110 ] → Non-
                                 zero
```

Error is detected

(c) Error pattern: 10011 000 000 0000
Code word: 100100 110 1111 00
Received: 0000 1011 0111 1100

```
                 0000 1010 100
         _____
   10011 | 0000 1011 0111 1100
           00000
           _____
            00010
            00000
            _____
             00101
             00000
             _____
              01011
              00000
              _____
               10110
               10011
               _____
                01011
                00000
                _____
                 10111
                 10011
                 _____
                  01001
                  00000
                  _____
                   10011
                   10011
                   _____
                    00000
                    00000
                    _____
                     00000
                     00000
                     _____
                      0000
```

Error Not Detected