

Lec 11.

Ex. 1.a

$$R = \frac{b}{n} = \frac{8}{6} = \frac{4}{3} = 1\frac{1}{3} = 1.333$$

Ex. 1.b

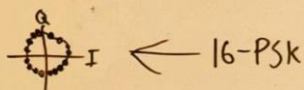
$$f_{space} = 500 \text{ kHz}, f_{mark} = 700 \text{ kHz},$$

$$R = 10 \text{ kbps}$$

$$BW = \Delta f + 2 \cdot R = 200 \text{ kHz} + 2 \cdot 10 \text{ kbps} = 220 \text{ kHz}$$

Ex. 2.a

What representation



Ex. 2.b

16 symbols in the representation

Ex. 2.c

$$\log_2(16) = 4 \left[\frac{\text{bits}}{\text{symbol}} \right]$$

Ex. 2.d

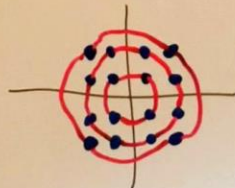
bit rate?

$$4 \left[\frac{\text{bits}}{\text{symbol}} \right] \cdot 10000 \left[\frac{\text{symbol}}{\text{s}} \right] = 40000 \left[\frac{\text{bits}}{\text{s}} \right]$$

Ex. 3.a

$$4 \left[\frac{\text{bits}}{\text{symbol}} \right]$$

Ex. 3.b



Ex 4.a

$x^3 + x + 1$ CRC polynomial

number of bits are equal to degree of the polynomial. Therefore 3

Ex 4.b

Step 1:

The message: 11011

Step 2:

Append: 000

Step 3:

Divisor: 1011

$$\begin{array}{r} 00000 \\ 1011 \overline{) 11011000} \\ \underline{1011} \\ 0110 \\ \underline{1011} \\ 01100 \\ \underline{1011} \\ 01110 \\ \underline{1011} \\ 01010 \\ \underline{1011} \\ 000 \end{array}$$

Data CRC
11011000

4.c

$$\begin{array}{r} 0000 \\ 1011 \overline{) 1101000} \\ \underline{1011} \\ 01100 \\ \underline{1011} \\ 01110 \\ \underline{1011} \\ 01010 \\ \underline{1011} \\ 01011 \\ \underline{1011} \\ 0100 \end{array}$$

so yes

$$\begin{array}{r} 0000 \\ 1011 \overline{) 1101100} \\ \underline{1011} \\ 01100 \\ \underline{1011} \\ 01110 \\ \underline{1011} \\ 01010 \\ \underline{1011} \\ 01011 \\ \underline{1011} \\ 0100 \end{array}$$

Ex 4.b
error check

$$\begin{array}{r} 11011001 \\ 1011 \overline{) 11011001} \\ \underline{1101} \\ 0001 \\ \underline{1011} \\ 1100 \\ \underline{1011} \\ 1110 \\ \underline{1011} \\ 1011 \\ \underline{1011} \\ 000 \end{array}$$

no error