2020 EBU5302 Week Four Problems

1. For MFSS, with $f_c = 250kHz$, $f_d = 25kHz$ and M=8, list all the frequency assignments for each of the data combinations. What is the data rate?

$f_1 = 75kHz$	000
$f_2 = 125kHz$	001
$f_3 = 175kHz$	010
$f_4 = 225kHz$	011
$f_5 = 275kHz$	100
$f_6 = 325kHz$	101
$f_7 = 375kHz$	110
$f_8 = 425kHz$	111

$$R = \frac{1}{T} = 2Lf_d = 150kbps$$

2. A system transmits at 30 kbps, sending 3 bits per symbol. The time between hops for a FHSS system is 0.125ms. Is the system using slow-frequency-hop spread spectrum or fast-frequency-hop spread spectrum?

$R = 30\ kbps$, L= 3, $T_c = 0.125ms$,

$R_S = \frac{R}{L} = 10\ kbps$, $T_S = \frac{1}{R_S} = 0.1ms$,

$T_c > T_S$, so a slow-frequency-hop spread spectrum

3. A multilevel digital communication system sends of 16 possible levels over the channel every 0.8ms?
    1) what is the number of bits corresponding to each level?   4 bits
    2) What is the baud rate?   1250kbps
    3) What is the bit rare?   5kbps

4. If the received signal level for a particular digital system is -151dBW and the receiver system effective noise temperature is 1500 K, what is E_b/N_0 for a link transmitting 2400bps?

$(E_b/N_0)_{dB} = -151\ dBW - 10 \log 2400 - 10 \log 1500 + 228.6\ dBW = 12\ dBW$

$$R_u = r\sqrt{3N}$$

Power transmitted by a base station is P so interference from the 6 co-channel cells is:

$$P_i = \frac{6P}{d^4} = \frac{6P}{R_u^4} = \frac{6P}{\left(r\sqrt{3N}\right)^4} = \frac{6P}{9r^4 N^2} \qquad \frac{P_{i7}}{P_{i3}} = \frac{3^2}{7^2} = \frac{9}{49} = -7.4\text{dB}$$