

2020 EBU5302 Week Four Problems

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

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

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

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?

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

$$R_s = \frac{R}{L} = 10\text{ kbps}, T_s = \frac{1}{R_s} = 0.1\text{ms},$$

$$T_c > T_s, \text{ so a slow-frequency-hop spread spectrum}$$

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 rate? 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?

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

5. In a simple free-space radio propagation model, the received signal power is proportional to $1/d^4$, where d is distance. Calculate the interfering power from the co-channel cells in a 7-cell cluster (P_{i7}) and compare it with the interfering power in a 3-cell cluster – i.e. evaluate P_{i7}/P_{i3} in dB. Assume the cell radius is the same in each case.

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

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

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