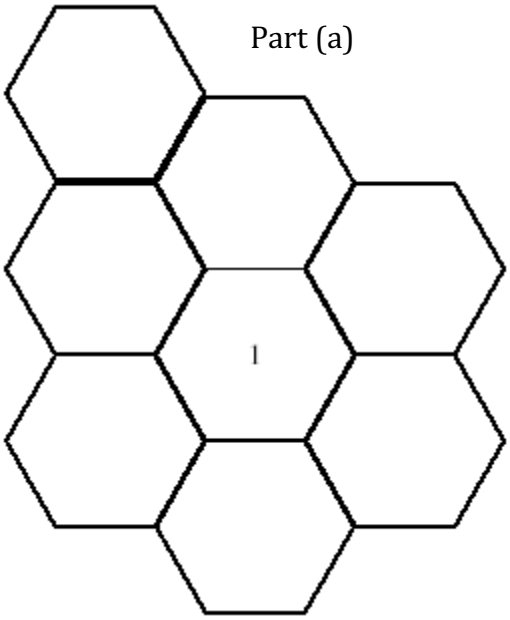
INFSCI1072/TELCOM 2700: Wireless Networks
Homework 6

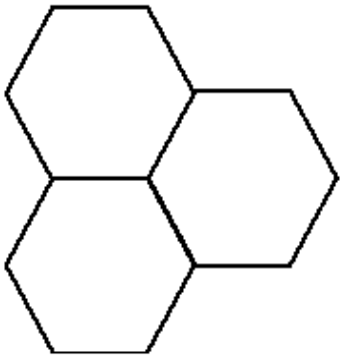
Answer the following questions.

1. Consider a reuse partitioning system where the macrocells have a reuse factor of 12 and the microcells have a reuse factor of 7. What should be the radius of the microcell for the SIR to be the same as the macrocell?
2. You are operating a cellular network with 30 KHz AMPS traffic channels 1 through 12. Labeling the frequency channels as {f1, f2, f3, f4, f5, f6, f7, f8, f9, f10, f11, f12}. (a) Place the frequency channels in the cells below such that a frequency reuse cluster size of 3 is used. (b) How would 120^{o} sectoring effect the frequency assignment of part (a)? Illustrate on a single cluster of 3 cells below.

Part (a)



Part (b)



3. If you have ample bandwidth, but very low SNR, which of these modulation schemes would you pick and why? – QAM and orthogonal signaling.
4. Consider slide 49 of Lecture 6. Assume that the energy of a signal point of each constellation corresponds to the square of the *distance* of the signal point from the origin. What is the average energy per symbol for the 8-PSK and 16-QAM constellations? Assume that each symbol has the same chance of being transmitted.
5. The Q-function that describes the error probability of most digital data transmission systems is related to the complementary error function (erfc) that is commonly used in other fields (e.g., diffusion of electrons). The relationship is given by $Q(x) = 0.5\ \mathrm{erfc}(x/\sqrt{2})$. Most mathematical software tools (e.g., Matlab or R) provide you capability of evaluating the complementary error function. The following table gives the expressions for the probability of error of various

modulation schemes in an AWGN channel in terms of the complementary error function. Plot the error rate curves as a function of the energy per bit to noise ratio ($E_b/N_0 = \gamma_b$). γ_b should be expressed in absolute values in these expressions. However plot the error curves as a function of γ_b in dB. Use R or Matlab.

Modulation Scheme	BER Formula
Binary Phase Shift Keying	$\frac{1}{2}\text{erfc}\sqrt{\gamma_b}$
Differential Binary Phase Shift Keying	$\frac{1}{2}e^{-\gamma_b}$
Binary Frequency Shift Keying (Coherent)	$\frac{1}{2}\text{erfc}\sqrt{\gamma_b/2}$
Frequency Shift Keying (Noncoherent Detection)	$\frac{1}{2}e^{-\frac{\gamma_b}{2}}$

6. What is the E_b/N_0 requirement for the above four schemes for a BER of 10^{-3} in an AWGN channel?