You will build two spread spectrum transmitters and receivers in this laboratory. Your final report must be typed and any figures present should not be sketched by hand. Equations should be typed in their proper form, not as computer language approximations (i.e., use LATEX or an equation editor). Provide an introduction which uses a system diagram to explain the major subsystems and their functions. Explain the theory using equations and graphs as necessary. Explain how you arrived at different values for components using theory and show that the experimental result is as expected. All circuits must be present in enough detail to be repeated exactly. Show explicitly where you have used any reference and provide a bibliography including links to any relevant web documents. You do not need to attach data sheets given that you provide a reference. Include a final section where you compare the theory predictions and the experimental results, and discuss any interesting observations, design problems and solutions. Use images whenever possible, and make sure they convey the information clearly. Any voltages shown must be clearly and uniquely labeled in the figure and in a corresponding circuit. Remember to analyze the waveforms both in the time and frequency domains.

You are highly encouraged to explore different circuits which perform similar functions and make comparisons between them. Perform as many experiments as you wish to characterize the behavior of any subsystem or groups of subsystems.

(i) Create a system diagram of two spread spectrum (SS) transmitters and two receivers, where the output of the transmitters is summed and fed into each receiver. The system diagram must show functional blocks, not components or chip numbers and pins (you will do that in later parts).

(ii) Read the notes posted on the website regarding the generation of pseudo-random noise. Implement a generator similar to the one shown in Figure 9.89 of the notes. You may use a 555 timer as an adjustable clock. A useful shift register is the CD74HC164E (If you feel ambitious, use two to generate a 16-bit sequence!). You may also need a SN74HC86N XOR chip.

(iii) The circuit shown below is based on the switch modulator you used in the AM laboratory. It will modulate a bipolar signal applied between I01 and ground by using
another bipolar carrier applied between I02 and ground. Note that a really wide variety of resistor values will work (I have used up to 100K!), so don’t use typical values (1k, 10K, etc.) which will run out quickly. If you choose to use this circuit, explain how it works. Hint: since you will be using several op amps, it may be tidier to use a quad op amp. Figure out your layout before constructing this circuit!

(iv) Construct suitable input and output subsystems to enhance your intuitive understanding of the system behavior (e.g., audio input and output).

(v) Remember that you must integrate the output of the demodulator. What circuit performs this function?

(vi) Borrow a second function generator (we don’t have enough, so please be considerate), and send two different signals through the same channel using shifted sequences from your pseudo-random generator.

(vii) If you modulate using the clock output directly (assuming it is bipolar), you will recreate an AM modulator. Compare the interference of two AM signals, two SS signals, and an AM signal with a SS signal.

(viii) (Optional extension) Try different modulation or demodulation schemes and compare them.

(ix) (Optional extension) Perform any additional experiments or add any additional circuits to increase your understanding of the circuit. Remember to show formally and clearly any additions in your report.

(x) *Remember to have fun!* Talk to your instructor if you feel stuck or without direction.