Beijing Dublin International College

EEEN3006J Wireless Systems

Tutorial Questions

Problem 1: Describe how frequency shifting is carried out in a transmitter. Why do we use this technique rather than creating the signal directly at radio frequency?

Problem 2: What is a non-linear system? What are the consequences of amplifier non-linearity for amplitude and frequency modulated signals? Explain the use of a pre-distortion stage.

Problem 3: Discuss the advantages and disadvantages of software defined radio. What parts of a receiver should be digital, and what parts should be analogue?

Problem 4: Draw the block diagram of a heterodyne receiver and explain its operation. What filter in this design is suitable for the use with a SAW filter, explain why?

Problem 5: What is the image frequency problem? The figure below shows an image-rejecting frequency shift. Prove that this rejects signals at the image frequencies.
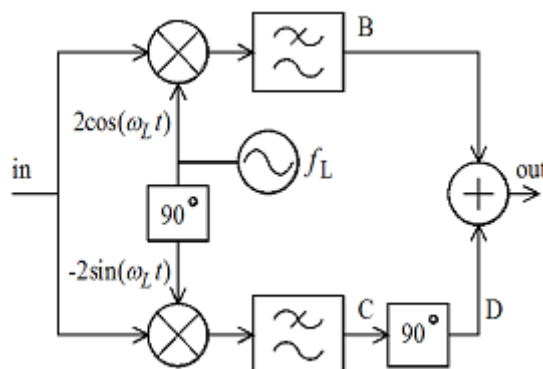
Problem 6: Explain how a phase-locked loop (PLL) can be used for frequency synthesis. Sketch the response of the components of a PLL to a step change in the phase of the input signal to the loop.

Problem 7: A frequency synthesis unit must provide a stable sinusoidal output for a range of 50kHz channels with in the range 440 to 460 MHz. Explain how this could be achieved using fractional-N synthesis. What are the values for fref, N, k and R for the channel with centre frequency at 455MHz.

Problem 8: From the block diagram of an oscilator circuit, derive the Barkhausen criterion for an oscillator composed of an amplifier with feedback.

Problem 9: A passband filter has fc at 550 KHz, a bandwidth of 40 kHz and a shape factor of 2 at 60/6 dB. What is the signal strength of a signal at after passing the filter:

    i)   1 W signal @ 560 kHz
    ii)   3.5 W signal @ 1.1 MHz

Problem 10: What is the meaning of the 1-dB compression point and the IIP3 point in a mixer component.

Problem 11: A signal of 10pW from an antenna is passed through a matched system (as shown below).

	G = 15	G = 25	G = .6	
	T = 350K	T = 220K	T = 400K	N_0
T= 415K	B_n =1.5MHz	B_n =1.5MHz	B_n =1.5MHz	
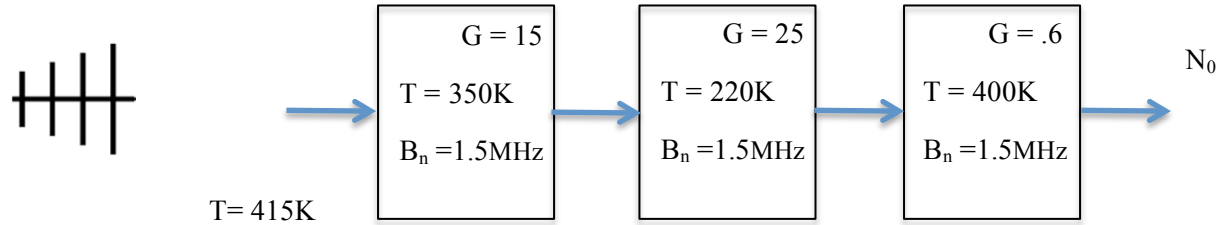
    i.   What is the noise temperature (T_e) of the system?

    ii.   What is the signal to noise ratio at N_0?

    iii.   What is the noise figure of the system?

    iv.   How can the components of the system be arranged for improved noise?

    v.   What is the noise figure of the re-arranged system?