EE-380L: Communication System Lab – Project

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Instructions:
- Carefully read each and every point that is written below
- Project has to be done in a group of two
- Proposal submission: 6 April 2016.
- Due Date: Friday 29 April 2016.
- Viva: Monday 2nd May 2016.

Objectives:
- Design and test an FM transceiver.
- To develop practical expertise in Software Defined Radios (the new emerging field in communication).
- To develop some intuition and practical experience in the field of radio frequency design and measurement.
- To demonstrate a simple oscillator by use of a bipolar junction transistor (BJT) and a tank circuit.
- Reception of the transmitted frequency modulated (FM) voice signal by an SDR receiver.

Tasks:
i)   Transmitter:
- Implement the Colpitts oscillator by using a BJT as shown in the schematics below
- Place an electric microphone between Port A and Port B
- Leave a wire hanging at the output. This will act as an antenna
- Place an FM receiver at some distance from the antenna and hear the signal being picked up by the microphone
- Understand the working of the circuit
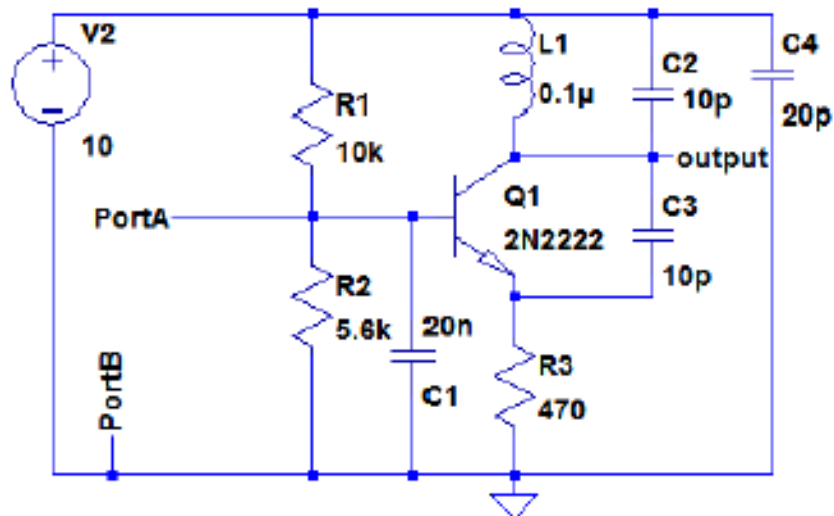
Note: You can change the oscillation frequency by modifying the values of inductor!

ii)   Receiver

- Implement software defined radio receiver using Matlab and RTL-SDR hardware.
- Design FM discriminator receiver in Matlab Simulink and interface it with RTL-SDR receiver block.
- And set a specific channel frequency of your receiver(the freuecy at which you are transmitting signal) to listen to your transmitted signal from your transmitter designed on PCB.
- Analyze the received spectrum using spectrum analyzer block(simulink) and also analyze time domain signal using time scope.

Methodology: (Implement FM discriminator receiver)

- Open Simulink and create a new model window save it with fm_receiver.slx.
- Take **RTL-SDR Receiver** block from Simulink library.
- Filter the output samples of **RTL-SDR Receiver** block using FIR filter with decimation factor of 10 and allow multi rate processing.
- Let x[n] be the output of now use blocks to do the following operation on x[n].

$$Y[n] = \text{angle}(conjugate(X[n]) * X[n-1])$$

Where $x^*[n]$ is the conjugate of x[n].

- Again filter the output Y[n] with **FIR** filter with decimation factor of 5.
- Now take the **FM De-emphasis Filter** and set the filter region to Europe + Asia and set the sampling frequency to 48 KHz.
- Now connect a speaker (**To Audio Device** block) and **Spectrum**

Analyzer block to the output of **FM De-emphasis Filter.**

Learning Perspective:

After doing this assignment, you should be able to answer the following questions:

- What is a tank circuit and how it works? Why it is used here? Locate it in the schematics given?
- How the frequency modulation is being done? And which part is responsible for doing FM in the circuit?
- How the oscillation frequency is calculated? And is dependent on which components? Locate!
- What is the role of different components which can be seen in the given schematics?
- Can an inductor be made if you are given with a wire? If yes, then how its' inductance is calculated?

Announcements:

- Grading policy and Submission policy will be announced subsequently.