Sample Syllabus: Digital Communication through SETI

Course Description: A sample syllabus for a SETI-focused course incorporating GNU radio software and real observations from the ATA. The sample is only given for 8 weeks, we plan to develop more detailed course for 12-weeks including extensive lab work incorporating GNU radio.

Prerequisite(s): Introduction of Electromagnetic Waves
Instructor: Vishal Gajjar **Course Website:** gajjarvishal.com

Tentative Schedule:

Week	Content
Week 1	• Electromagnetic waves basics • Lab: Propagation and capturing of radio waves and familiarize with `GQRX` and `GNU` radio softwares
Week 2	• Possible types of ETI radio transmissions • Lab: Use GNU radio software flow diagram to simulate different kinds transmitter sources such as continuous waveforms (sinewaves, chirp, squarewaves etc), different types of noise sources, pulsed radar signal sources, audio sources etc.
Week 3	• Radio Astronomy fundamentals I (Single dish) • Lab: Digitization, Nyquist Sampling, Fourier transform, bandpass filters through `SDRs`, `GQRX` and GNU radio
Week 4	• Radio Astronomy fundamental II (Limitations of single dishes in SETI and introduction to inteferometers) • Lab: Using `Delay`, `Multiply` and `Correlate` blocks in GNU radio to simulate interferometer response
Week 5	• Introduction to on-going SETI efforts around the world • Lab: Using `Jupyter − notebook` tutorial to find signals from Voyeger from observations taken with the ATA
Week 6	• Data science with SETI I (Data visualization techniques, distributions, outlier detection) • Lab: Use QT GUI in GNU Radio for a range of plot types, such as time series, FFT spectrograms, histograms. Using the `HistogramSink` to plot histograms of received data and use `GNUplot` block to find outliers.
Week 7	• Data Science with SETI II (correlation, regression analysis, basics of Machine Learning) • Lab: Using `PythonBlock`, carryout regression analysis to fit different distributions and use ML tools identify outliers.
Week 8	• Observations • Lab: Use easy-to-use ATA observation GUI to carryout real observations and display your results.