

Digital Communications (EE 332)

Assignment-1

Instructions

- Form groups of two students for this assignment.
- Use GNU Radio to create `.grc` files and prepare a detailed report with your observations and results.
- Compile all `.grc` files along with the report into a single ZIP file and upload it to teams.
- The submission deadline is **March 14 2025, 23:59**.

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1. Display and analyze a sinusoidal signal in both the time domain and the frequency domain using GNU Radio. Determine the sample rate from the time-domain graph.
 2. Perform digital modulation for BPSK, QPSK, 16-QAM and 64-QAM in GNU Radio.
 - (a) Visualize the output using a constellation plot.
 - (b) Introduce AWGN with a variance of 0.01 and visualize its impact on the constellation plot. Analyze how varying noise levels affect the plot's distortion.
 3. Set up a transmitter with varying bitrates of 100, 300 and 500 kbps with NRZ, RZ and Manchester pulse shapes.
 - (a) Plot and compare the spectrum of all 9 waveforms assuming binary antipodal signaling and comment on the results.
 - (b) Repeat for a 4-PAM signal constellation and for the same bitrates.
 - (c) Repeat for a QPSK constellation assuming that we have a passband communication situation.
 - (d) Compare the spectrum of (b) and (c). Comment on the results.
 - (e) For part (c), determine the symbol rate from the frequency-domain graph. Verify the bit rate. (Hint: Exploit cyclostationary property)
 4. Set up a QPSK transmitter with varying bitrates of 100, 300 and 500 kbps with RC pulse shape of excess bandwidth 10%, 25%, 50% and 75%.
 - (a) Plot the spectrum and compare.
 - (b) Plot the eye diagram and comment.
 5. Set up a BPSK and 16-QAM transmitter with a bitrate of 200 kbps using an RRC pulse shape with an excess bandwidth of 35%. Convert the signal to passband with an adjustable carrier frequency and analyze its impact on signal bandwidth and spectrum.