MINI-PROJECT

INTRODUCTION TO COMMUNICATION ENGINEERING

General regulations:

- It is either a single-based or group-based (recommended, maximum 3 students) project. For the latter, each member performs one task and understands another task.
- Write the report using the latex template (link: https://soict.hust.edu.vn/bieu-mau-va-quy-dinh-danh-cho-sinh-vien.html)
- Present the source code and the report to the instructor.
- Students are greatly appreciated to propose their own interesting tasks in this course.

Task 1: Modulate and demodulate amplitude shift keying (ASK) signal from a random binary sequence

1. Modulation: To perform the ASK modulation, the following instruction may be useful
   - Generate and plot the carrier signal
   - Generate and plot the binary data sequence
   - Perform ASK modulation and plot the ASK modulated signal
2. Demodulation: To perform the ASK demodulation, the following instruction may be useful
   - Correlate the ASK modulated signal with the carrier signal to generate decision variables
   - Obtain the demodulated binary data based on the decision variables
3. Investigate the ASK modulation/demodulation under the effects of Gaussian noise, the following instruction may be useful
   - Gaussian noise with zero mean and variance $N_0/2$ is added to the transmitted waveform as $r(t) = s(t) + n(t)$
   - Numerically compute the error probability
4. Theory: Derive the bit error probability of a Gaussian channel using the ASK modulation/demodulation used in your task

Task 2: Modulate and demodulate phase shift keying (PSK) signal from a random binary sequence

1. Modulation: To perform the PSK modulation, the following instruction may be useful
   - Generate and plot the carrier signals
   - Generate and plot the binary data sequence
   - Perform PSK modulation and plot the PSK modulated signal
2. Demodulation: To perform the PSK demodulation, the following instruction may be useful
   - Correlate the PSK modulated signal with the carrier signal to generate decision variables
   - Obtain the demodulated binary data based on the decision variables
3. Investigate the PSK modulation/demodulation under the effects of Gaussian noise, the following instruction may be useful
   - Gaussian noise with zero mean and variance $N_0/2$ is added to the transmitted waveform as $r(t) = s(t) + n(t)$

- Numerically compute the error probability

4. Theory: Derive the bit error probability of a Gaussian channel using the PSK modulation/demodulation used in your task

Task 3: Modulate and demodulate frequency shift keying (FSK) signal from a random binary sequence

1. Modulation: To perform the FSK modulation, the following instruction may be useful
   - Generate and plot the carrier signal(s)
   - Generate and plot the binary data sequence
   - Perform PSK modulation and plot the FSK modulated signal
2. Demodulation: To perform the FSK demodulation, the following instruction may be useful
   - Correlate the FSK modulated signal with the carrier signal to generate decision variables
   - Obtain the demodulated binary data based on the decision variables
3. Investigate the FSK modulation/demodulation under the effects of Gaussian noise, the following instruction may be useful
   - Gaussian noise with zero mean and variance $N_0/2$ is added to the transmitted waveform as $r(t) = s(t) + n(t)$
   - Numerically compute the error probability
4. Theory: Derive the bit error probability of a Gaussian channel using the FSK modulation/demodulation used in your task