# ASE 389P-7 Preliminary Exam 1

**Posting Date**: October 4, 2022

**Exam Rules:** Do problems on standard 8 1/2 by 11 inch paper. Hand in the completed exam by 10:00 A.M. on Friday, October 2 to Dr. Humphreys as a single pdf document submitted to Canvas. No collaboration or consultation is allowed with any other person besides Dr. Humphreys. He is willing to talk about problems if he's available. You may use non-human outside sources (e.g., books, papers, websites). If you use such sources, please list them.

1. [**15 points**] Problem set 1, Number 2, except use the file `trainout.wav` posted in the exam folder on Canvas. Turn in a paper copy of your source code and estimates of `xObs` and `dObs` to a precision of 0.1 meters. Note that to meet this precision, you will have to somehow extract an accurate digital (not just visual) Doppler time history from `trainout.wav`. You can do this with Matlab's spectrogram, for example.

2. [**15 points**] Problem set 1, Number 4.

3. [**10 points**] Problem set 1, Number 5. The extra credit will be worth 1 point.

4. [**5 points**] To measure the receiver temperature $T_R$ of a GNSS receiver and antenna setup, a friend recommends placing the receiver's antenna in a RF test enclosure such as the one in the Radionavigation Laboratory (seen here `https://ramseytest.com/forensic-test-enclosures`), but cryogenically cooled down to 5 K, and then measuring the noise power in the raw samples generated by the receiver. The enclosure effectively isolates the antenna from environmental noise. The antenna is an active antenna consisting of a patch element, a (passive) filter, and an amplifier. Is this a valid approach for measuring $T_R$? Why or why not?

5. [**10 points**] Problem set 2, Number 2.

6. [**10 points**] Problem set 2, Number 4.

7. [**10 points**] Problem set 2, Number 6.

8. [**15 points**] Problem set 2, Number 9.

9. [**10 points**] Use the `generateLfsrSequence` function you wrote for Problem Set 2 and your lecture notes to answer the questions.

   Which of the following characteristic polynomials correspond to maximal length sequences for a 9-stage linear feedback shift register? Of those that do, which pairs of polynomials correspond to so-called *preferred pairs* of m-sequences, i.e., m-sequences that can be shifted and summed (modulo 2) to generate a family of Gold codes? Hand in your answers and a paper copy of your source code.

$$
\begin{aligned}
f_1(D) =& 1 + D^4 + D^9 \\
f_2(D) =& 1 + D^3 + D^5 + D^6 + D^9 \\
f_3(D) =& 1 + D^3 + D^5 + D^8 + D^9 \\
f_4(D) =& 1 + D^3 + D^4 + D^6 + D^9 \\
f_5(D) =& 1 + D^3 + D^7 + D^8 + D^9 \\
f_6(D) =& 1 + D^2 + D^9
\end{aligned}
$$