CMSC 442/653
Instructor: Dr. Lomonaco
Homework 4

- **Listening Assignment:** Listen to Smetana's Moldau
- **Reading Assignment:** http://www.cs.umbc.edu/~lomonaco/f06/653/handouts/Peterson-Pages22-25.pdf
- **Optional Reading assignment:** Peterson & Weldon, "Error-Correcting Codes," MIT Press, (Second Edition), Chapters 2, 3, 6.

1) Put the following matrix into reduced echelon canonical form over $GF(3)$

$$\begin{pmatrix} 0 & 0 & 2 & 2 & 0 & 2 \\ 2 & 2 & 0 & 2 & 1 & 2 \\ 1 & 1 & 2 & 0 & 2 & 2 \\ 1 & 1 & 0 & 1 & 2 & 1 \end{pmatrix}$$

Please show all your steps, and the reason for all your steps.

2) Put the following matrix into reduced echelon canonical form over $GF(11)$

$$\begin{pmatrix} 0 & 0 & 2 & 2 & 0 & 2 \\ 2 & 2 & 6 & 8 & 4 & 8 \\ 1 & 1 & 5 & 6 & 2 & 5 \\ 1 & 1 & 3 & 4 & 2 & 7 \end{pmatrix}$$

Please show all your steps, and the reason for all your steps.

3) Find the inverse of the following matrix over $\mathbb{Z}_6$

$$\begin{pmatrix} 1 & 2 & 1 \\ 3 & -2 & 4 \\ 0 & 1 & 0 \end{pmatrix}$$

4) Let V be the linear code over $GF(3)$ determined by the generator matrix

$$G = \begin{pmatrix} 0 & 2 & 1 & 2 & 0 \\ 2 & 1 & 1 & 0 & 2 \\ 2 & 2 & 0 & 1 & 1 \end{pmatrix}$$

a) What is the length n of V.
b) Put the generator matrix of V in echelon canonical form to find the dimension k of V.

c) Find a parity check matrix H for the linear code V.

5) Let V be the binary linear code given by the generator matrix

$$G = \begin{pmatrix} 1 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \end{pmatrix}$$

a) Use the generator matrix to create a list of all code vectors of V.
b) Use the list generated in a) to determine the minimum d distance of V
c) Explain why it is easier to find the minimum distance for a linear code than it is for a non-linear code.
d) Find a parity check matrix H of the binary linear code V.

6) Let V be the binary linear code given by the parity check matrix

$$H = \begin{pmatrix} 1 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 & 1 \end{pmatrix}$$

Find a generator matrix G for V.