Name_____ **Student ID**_____ **Colleges & Schools**_____ **Department**_____

Homework Unit 1

1. (a) Show how to represent each of the numbers (7-1), (7^2-1), and (7^3-1) as base 7 numbers.

   (b) Generalize your answers to part (a) and show how to represent (k^n-1) as a base k number, where k can be any integer larger than 1 and n any integer larger than 0. Give a mathematical derivation of your result.

2. (a) It is possible to have negative weights in a weighted code for the decimal digits, e.g., 8, 4, -2, and -1 can be used. Construct a table for this weighted code.

   (b) If x is a decimal digit in this code, how can the code for 9-x be obtained?

3. An alternative algorithm for converting a base 20 integer, $d_{n-1}d_{n-2}\cdots d_1d_0$, into a base 10 integer is stated as follows: Multiply d_i by 2^i and add i 0's on the right, and then add all of the results.

   (a) Use this algorithm to convert $GA7_{20}$ to base 10. (G_{20} is 16_{10}.)

   (b) Prove that this algorithm is valid.

   (c) Consider converting a base 20 fraction, $0.d_{-1}d_{-2}\cdots d_{-n+1}d_{-n}$ into a base 10 fraction. State an algorithm to the one above for doing the conversion.

   (d) Apply your algorithm of part (c) to $0.FA7_{20}$.

4. Let $B=b_{n-1}b_{n-2}\cdots b_1b_0$ be an n-bit 2's complement integer. Show that the decimal value of B is $-b_{n-1}2^{n-1}+b_{n-2}2^{n-2}+b_{n-3}2^{n-3}+\cdots+b_12+b_0$. (Hint: Consider positive (b_{n-1}=0) and negative (b_{n-1}=1) numbers separately, and note that the magnitude of a negative number is obtained by subtracting each bit from 1 (i.e., complementing each bit) and adding 1 to the result.)