Problem 1 Engineering Mathematics P1: Discrete Math

1. Consider the following Boolean function:

$$f(w, x, y, z) = wxyz + wxyz' + wx'yz + wx'yz'wxy'z' + wxy'z + w'x'y'z$$

(a) Minimize f. (You may use any method but show your work.)

(b) What is the minimum number of inputs required to implement f?
   Explain.

(c) Draw the schematic diagram (logic gates) that implements the minimized f.

2. The first Biologically-Inspired NOT gate was implemented with 40 cells per Petri plate in 2020. The number of cells per plate has grown on average 10% every year.

(a) Write the recurrence relation with the initial condition(s).

(b) Find the closed form. Show your work and be sure to justify your

answer. (c) How many cells will there be in the year 2030?

3. For each of the following functions, use order analysis (big-O) notation to identify a reason able upper bound.

(a) $f_0(n) = 3n^4 + log_3n$
(b) $f_1(n) = 3n^2 + 3n^3$
(c) $f_2(n) = 3n^2 + 3n + n$
(d) $f_3(n) = n(3 + log_2n)$

4. For each of the following functions, use order analysis (big-O) notation to identify a reason able upper bound *and* provide a C and n_0 that justifies your answer.

• $f_4(n) = 3n + 30$
• $f_5(n) = (n + 1)(2n + 2)$
• $f_6(n) = n! + 1$

5. Place function f_4 through f_6 in the order of their growth rate. (I.e., list the highest upper bound to lowest upper bound.)