

# EECS 151/251A Homework 1

Due Friday, Sept 11<sup>th</sup>, 2020

## Problem 1: Dennard Scaling [4 pts]

Imagine that we still live in the world of ideal Dennard scaling. You designed a brilliant laptop microprocessor that runs at 4GHz, but dissipates 45W. What would be its power and performance in the next technology node, with features that are scaled by a factor of 0.8?

## Problem 2: Wafer Yield [4 pts]

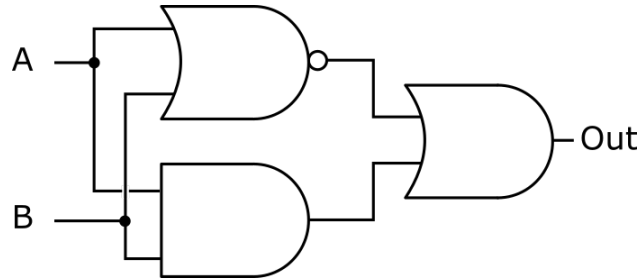
You want to fabricate a new chip using TSMC's 5nm node. You will use 600 mm wafers with  $\alpha = 3$  and a defect per unit area of  $0.001/\text{mm}^2$ . The die area is  $1\text{ cm}^2$  and the wafer cost is \$80k. What is your die yield and die cost?

## Problem 3: Power and Energy [6 pts]

- (a) Briefly explain why as a designer you would be concerned with the following. Give 2 reasons each. Think about the applications of your design. [1 pt each]
- Energy Consumption
  - Power Consumption
- (b) You find yourself are in charge of designing a battery and charger for a new laptop that dissipates 50W. If you expect this laptop to have 9 hours of battery life, how much energy (in Joules) must the battery hold at a full charge? [2 pts]
- (c) To ensure that users can use the laptop while it charges, you decide that the laptop should charge from 0 to 100% in 2 hours if it is in use. How much power should the charger be able to supply for this to be possible? [2 pts]

### Problem 4. Boolean Logic [6 pts]

- (a) For the digital logic circuit shown below, give the truth table. What is the equivalent boolean operation of this circuit? [3 pts]



- (b) By inspection, draw the equivalent circuit for the given truth table using simple logic gates. You should not use more than 4 logic gates. [3 pts]

A	B	C	Out
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

### Problem 5. Noise Margins [5 pts]

Estimate  $V_{OH}$ ,  $V_{IH}$ ,  $V_{OL}$ ,  $V_{IL}$ , and the noise margins for the voltage transfer characteristic shown below. The dots along the line show roughly where the  $slope = -1$ .

