PHY 335 Fall 2024

Problem 1. Answer the following problems:

(a) Draw the Thevenin equivalent of this circuit (I'm not going to bother drawing the circuit, as the answer is literally always the same).

(b) What is the cutoff frequency for a high-pass filter?

(c) Write $\overline{A}\,\overline{B}$ without using the AND operation.

(d) Which is correct: in an npn transistor, the base input is directly connected to...

- one of the n-doped layers
- both n-doped layers
- the O_3 layer
- the p layer.

(e) Convert 27 to binary and hexadecimal.

Problem 2. "Figure": Flip-flop circuit feeding into a NAND; V_{in} input into CLK, $\overline{Q} \to D$, Q as one of the inputs of the NAND, V_{in} to the other.
Problem: draw CLK, Q, and V_{out} (where V_{out} is the output of the NAND).

Problem 3. Consider the following logic table.

A	B	C	OUT
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

(a) Find the logical expression corresponding to this table.

(b) Simplify as much as possible.

(c) Make this into a circuit using the normal gates (e.g. AND, OR, NOT, etc.).

Problem 4. AC-coupled emitter follower without R_C resistor. $I_C = 2\text{mA}$. $V_{\text{CC}} = 20\text{V}$. Output voltage $V_q = V_{\text{CC}}/2$. Assume $\beta \geq 100$.

(a) Find R_E.

(b) Find V_B, V_E, and V_C when things aren't moving.

(c) Find R_2/R_1.

(d) Find the maximum values of R_1 and R_2 assuming we want the Thevenin resistance to be 1% of the load. (Don't forget β).

Problem 5. You're given an IC that's taped up. Your task is to investigate its features.

(a) What's the number on your IC? (For grading purposes I assume).

(b) Find the logic table of the IC. What kind of gate is it?

(c) Connect all of the gates of the IC together, with B being an input to all of them (i.e. you have the input of one gate be another gate, and the other input is always B). What value of B gives makes the answer only dependent on A?

(d) Put a logic pulse through your circuit to demonstrate this; show it to the professor beforehand to not blow up stuff.

(e) Measure the propagation delay of the circuit; let the professor take a picture of the scope after you're done.

(f) What's the propagation delay of an individual gate (with error)?