EECS 100B, Spring 1982
Midterm #1
Professor J.M. Smith

Problem #1

An n-type silicon wafer has 10^{15} phosphorous atoms per cubic centimeter. Boron is diffused into the crystal with the surface concentration of $C_0=10^{19}$ per cubic centimeter. The diffusion constant D is 8 cm^2 per second. The time of diffusion is only 3.125×10^{-10} seconds. The resulting distance constant L is 10^{-6} meters. What is the concentration of p-type boron at the depth of 2.5 micrometers?

Problem #2

A DTL NAND gate has all inputs tied together at 5 volts. The resistor to the power supply of 5 volts from the input diode anodes is 5000 ohms, the collector resistor is 2000 ohms. The load capcitance from the collector to ground C_L is 50 picofarads (50×10^{-12}). The capacitance from the input diode anodes to ground C_D is 10 picofarads.

(a) Assuming C_D is negligible, what is the time constant of the output circuit when the signals to all input diodes go to zero simultaneously and instantly?

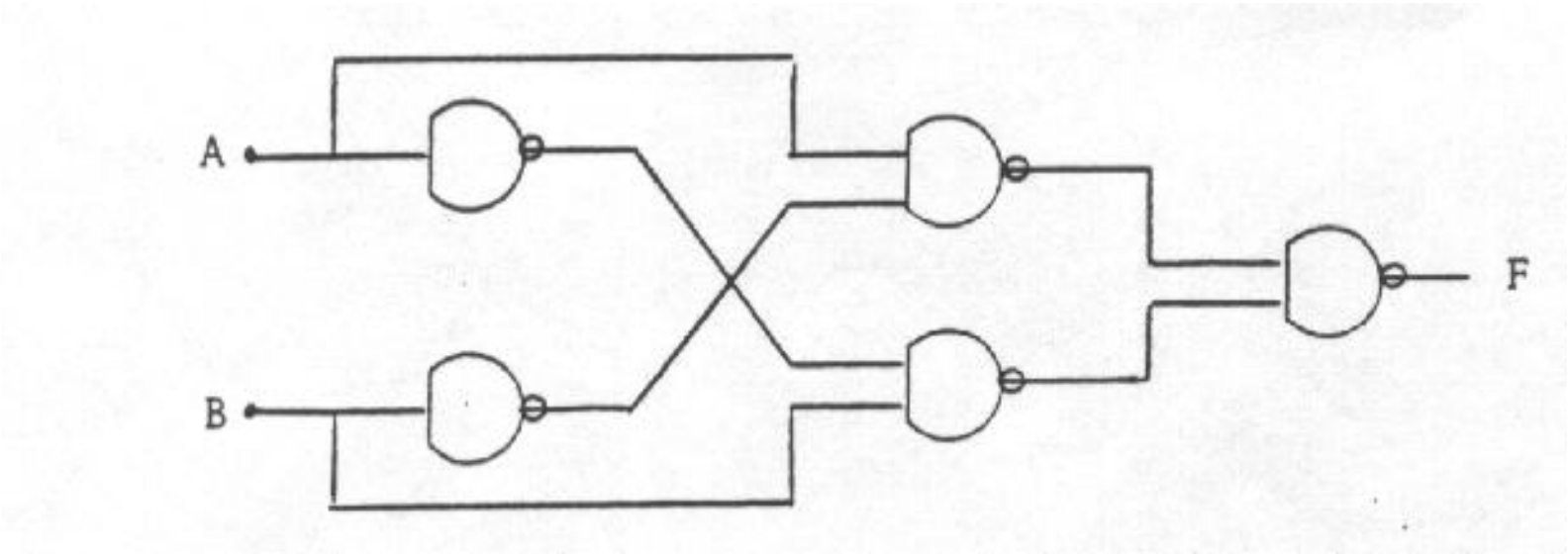
(b) Assuming C_L is neglible and all inputs are zero volts, what is the time constant of the voltage at the diode anodes when the signals to all input diodes go to 5 volts simultaneously and instantly?

Problem #3

Draw the circuit for a TTL NAND gate with push-pull output circuit. Show at least two inputs.

Problem #4

Construct the truth table for



Problem #5

$$F = \overline{(A + \overline{A}\,B) + \overline{(C + D)}} + \overline{A}\,B$$

Reduce this to the sum of products form.

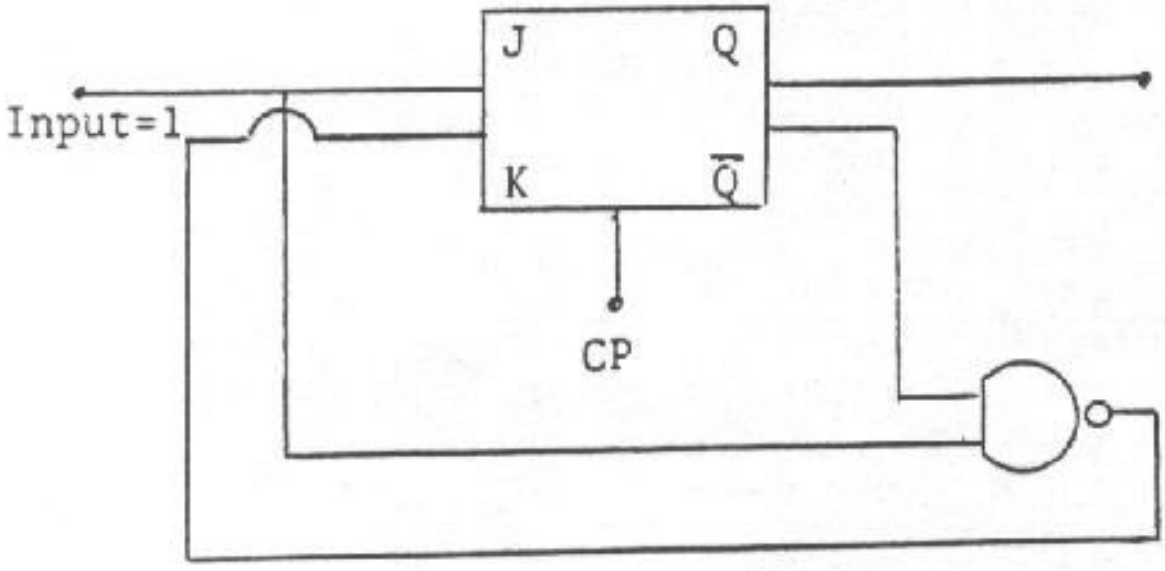
Problem #6

Draw the Karnaugh map for F in Problem (5).

Problem #7

Synthesize F with NAND gates.

Problem #8



In this circuit, the input to J is always 1.

Each clock pulse last only long enough for one transition to occur. Finish the table below for three clock pulses, and then set J=0 before the fourth clock pulse for the last transition.

Before Transition				After Transition			
J	K	Q	NOT(Q)	J	K	Q	NOT(Q)
1	1	1	0				
