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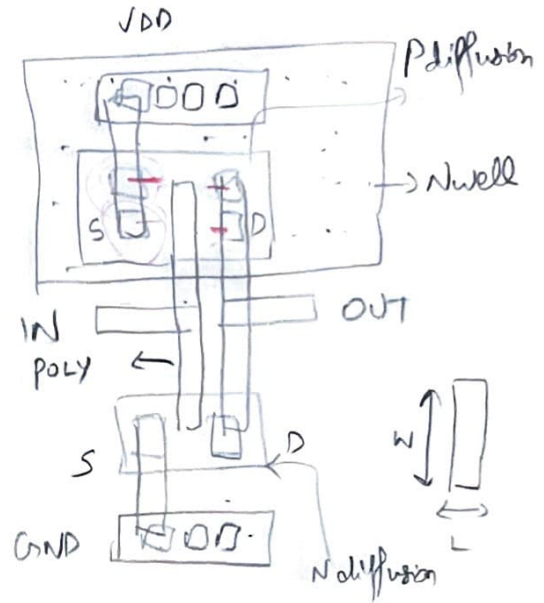
Person No.

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CSE 493/593 FALL 2024 QUIZ 1 - Duration: 50 min Total: 50 points

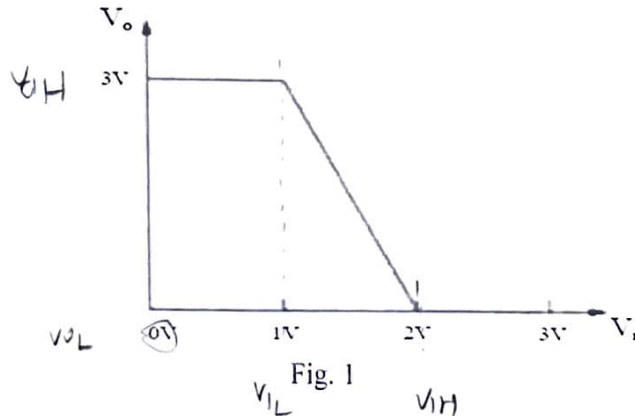
1. [10 points] Draw the layout of a Complementary CMOS inverter and identify the following:

- a. Input ✓
- b. Output ✓
- c. Poly ✓
- d. p-diffusion ✓
- e. n-diffusion ✓
- f. Vdd ✓
- g. GND ✓
- h. W of the NMOS transistor ✓
- i. L of the NMOS transistor ✓



2. [10 points] Given in Fig. 1 is the Voltage Transfer Characteristics of an inverter. Calculate the following:

- a. $V_{IL} = 1V$
- b. $V_{IH} = 2V$
- c. $V_{OL} = 0V$
- d. $V_{OH} = 3V$
- e. $N_{ML} = V_{IL} - V_{OL} = 1 - 0 = 1V$
- f. $N_{MH} = V_{OH} - V_{IH} = 3 - 2 = 1V$



3. [10 points]

- (a) What is the logic function implemented by the static CMOS circuit shown below?
- (b) Size the NMOS and PMOS devices for Performance (mark transistor size in (b) below)
- (c) Additionally, size the NMOS and PMOS devices for symmetric rise and fall times (mark transistor sizes in (c) below).

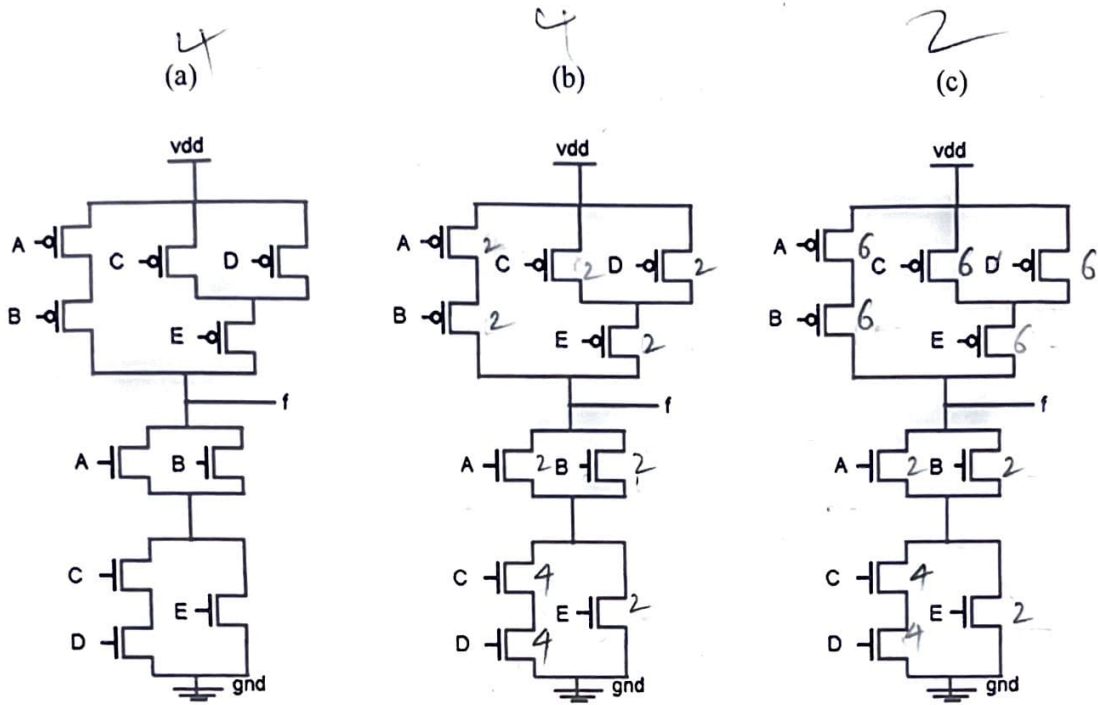


Fig. 2

$$(CD + E)(A + B)$$

4. [10 pts] What is the logic function (D) implemented by this circuit in Fig 1?

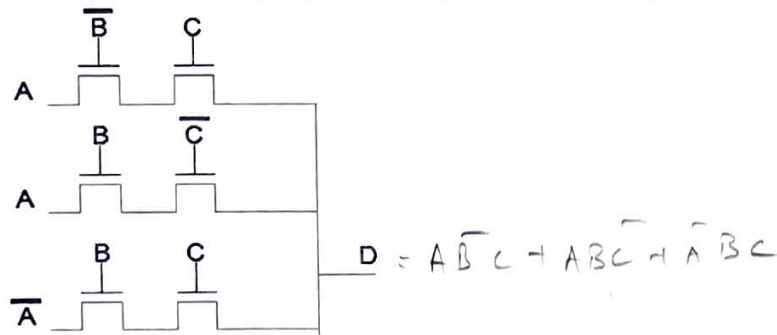


Fig. 3

5. [10 points] Input and output waveforms of a CMOS inverter are given in Fig. 4 below.

a. Calculate the propagation delay (t_p) (Hint: Calculate t_{pHL} and t_{pLH}); Show the steps

$$t_{pHL} = 5 - 3 = 2$$

$$t_{pLH} = 11 - 9 = 2$$

$$t_p = \frac{2 + 2}{2} = 2$$

b. Calculate (i) rise time and (ii) fall time.

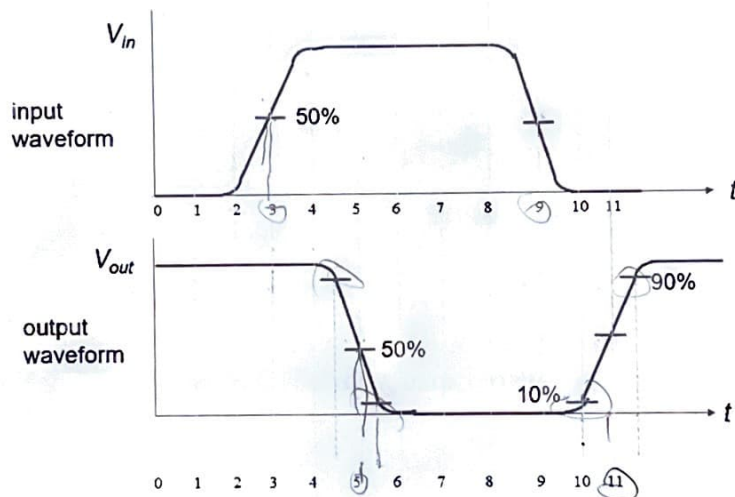


Fig. 4

$$t_f = 5.5 - 4.5 = 1$$

$$t_r = 12 - 10 = 2$$