

Homework # 2

[Textbook]

Exercise 4.4

EXERCISE 4.4

- a) Plot the i_A vs. v_A characteristics for the nonlinear network shown in Figure 4.49. Assume the diode is ideal.

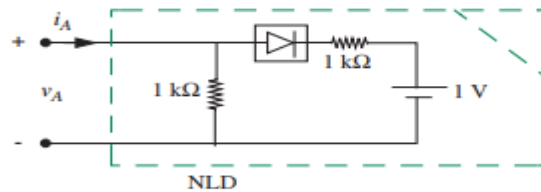


FIGURE 4.49

- b) The nonlinear network from part (a) is connected as shown in Figure 4.50. Draw the load line on your $v-i$ characteristics from part (a), and find i_T .

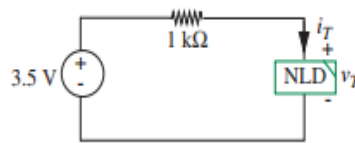


FIGURE 4.50

Problem 4.4

PROBLEM 4.4

- a) Assuming the diode can be modeled as an ideal diode, and $R_1 = R_2$, plot the waveform $v_o(t)$ for the circuit in Figure 4.57, assuming a triangle wave input. Write an expression for $v_o(t)$ in terms of v_i , R_1 , and R_2 .
- b) If the triangle wave has a peak amplitude of only 2 volts, and $R_1 = R_2$, a more accurate diode model must be used. Plot and write an expression for v_o assuming that the diode is modeled using an ideal diode in series with a 0.6-volt source. Draw the transfer curve v_o versus v_i .

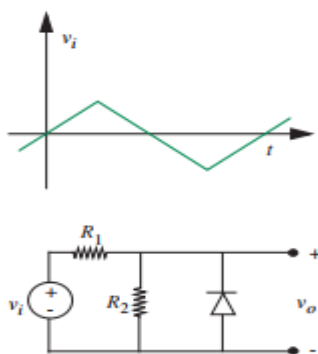


FIGURE 4.57

Problem 4.13

PROBLEM 4.13 The circuit shown in Figure 4.67 contains a nonlinear element with the following properties:

$$\begin{aligned} i_N &= 10^{-4} v_N^2 \quad \text{when } v_N > 0 \\ i_N &= 0 \quad \quad \quad \text{when } v_N < 0 \end{aligned}$$

where i_N is in A and v_N is in V.

The output voltage, v_{OUT} , may be written approximately as the sum of the two terms:

$$v_{OUT} \simeq V_{OUT} + v_{out}, \quad (4.94)$$

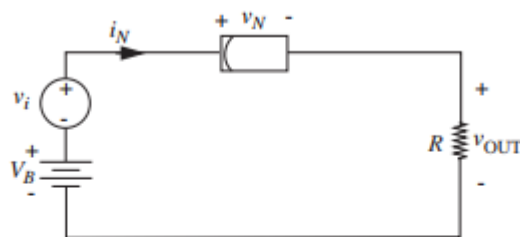


FIGURE 4.67

where V_{OUT} is a DC voltage produced by V_B and v_{out} is the incremental voltage produced by the incremental voltage source v_i .

Assuming that $v_i = 10^{-3} \sin(\omega t)$ V and V_B is such that the nonlinear element operates with $V_N = 10$ volts, determine the incremental output voltage v_{out} .

Exercise 5.8

EXERCISE 5.8 A logic gate obeys a static discipline with the following voltage levels: $V_{IH} = 3.5$ V, $V_{OH} = 4.3$ V, $V_{IL} = 1.5$ V, and $V_{OL} = 0.9$ V. (a) What range of voltages will be treated as invalid under this discipline? (b) What are its noise margins?

Problem 5.10

PROBLEM 5.10 Figure 5.42 illustrates input-output voltage transfer functions for several one-input one-output devices. For the voltage thresholds V_{OL} , V_{IL} , V_{OH} , and V_{IH} as shown, which of the devices can serve as valid inverters?

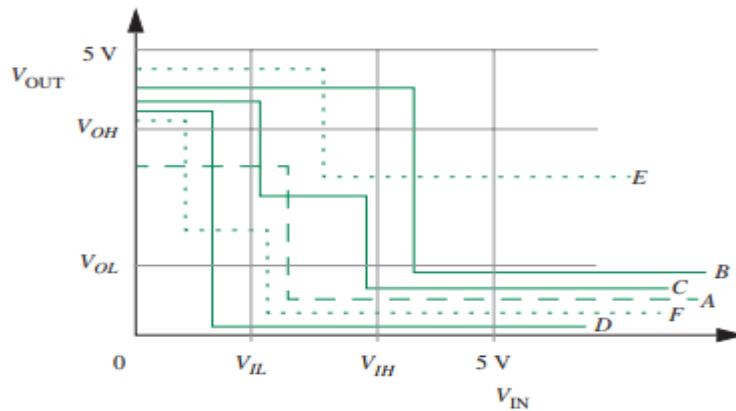


FIGURE 5.42

Exercise 6.3 (a) (b)

EXERCISE 6.3 Figure 6.60 shows an inverter circuit using a MOSFET and a resistor. The MOSFET has a threshold voltage $V_T = 2$ V. Assume that $V_S = 5$ V and $R_L = 10$ k Ω . For this exercise, model the MOSFET using its switch model. In other words, assume that the on-state resistance of the MOSFET is 0.

- Draw the input versus output voltage transfer curve for the inverter.
- Does the inverter satisfy the static discipline for the voltage thresholds $V_{OL} = 1$ V, $V_{IL} = 1.5$ V, $V_{OH} = 4$ V and $V_{IH} = 3$ V? Explain. (Hint: To satisfy the static discipline, the inverter must interpret correctly input values that are valid logic signals. Furthermore, given valid logic inputs, the inverter must also output valid logic signals. Valid logic 0 input signals are represented by voltages less than V_{IL} , valid logic 1 input signals are represented by voltages greater than V_{IH} , valid logic 0 output signals are represented by voltages less than V_{OL} , and valid logic 1 output signals are represented by voltages greater than V_{OH} .)

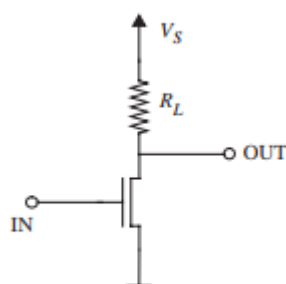


FIGURE 6.60

[Previous exams] 2019. 1 st exam

4. [15 points] 다음 다이오드에 대한 물음에 답하여라. Answer the following questions for the diode circuit below.

(a) [10 points] 이상적인 다이오드의 경우 출력 파형을 도시하여라. Draw the output waveform assuming that all diodes are ideal. (힌트 Hint: First assume that both diodes are turned-off to get the output waveform and find the range of input voltage that satisfies the assumption)

(b) [5 points] 다이오드의 turn-on 전압이 0.6V 인 경우의 출력 파형을 도시하여라. Draw the output waveform when the turn-on voltage of each diode is 0.6V.

