國立臺灣大學101學年度碩士班招生考試試題

1. (20%)

(a) Design a voltage regulator using a zener diode. The voltage regulator is to power a car radio at $V_L = 9$ V from an automobile battery whose voltage varies between 11 and 13.6 V. The current in the radio varies from 0 (off) to 100 mA (full volume).

(b) Find the line regulation and load regulation of your designed circuit.

2. (20%)

(a) Design a voltage follower using BJT transistors.

(b) Find the input resistance and the output resistance of your voltage follower.

(c) If your voltage source has a 500 Ω resistance, determine the collector current I_C such that the overall voltage gain will not be affected too much when the source resistance is doubled.

(d) Describe at least two ways by which you can bias the circuit.

3. (20%)

A measured open-loop gain of an internally compensated op amp is x dB and y dB at very low frequency and 100 kHz, respectively.

(a) Estimate A_0 (the dc gain), f_b (3-dB frequency), and f_t (unity-gain bandwidth).

(b) If your boss requests you to change the 3-dB frequency to 10 kHz, how would you do it?

4. (20%)

(a) Describe a three-input CMOS XOR logic circuit.

(b) List the advantages of using CMOS circuit compared with PMOS logic circuits.

5. (20%)

Design an amplifier using op amps and resistors. The output y of the designed amplifier is 100 times of the weighted average (magnitude) of two pairs of differential inputs: $(x_1 - x_2)$ and $(x_3 - x_4)$, i.e., $y = 100 \times \frac{2 \times (x_1 - x_2) + 3 \times (x_3 - x_4)}{5}$. The maximum possible resistance is 1 MΩ and each input signal must see the maximum possible input resistance.

試題隨卷繳回