*請依題號順序作答

一、簡答題(可以使用圖示輔助說明) (30%)

1. The operational amplifier is one of the major active components in the discrete circuit design. To promote the understanding of circuits during design stage, it is important to employ the ideal operational amplifier characteristics. Please describe at least three ideal operational amplifier characteristics. (6%)
2. The noise is always the most critical issue in the biomedical instrument. Therefore, it is important to undertand the noise source. Please list and explainat least two noise coupling mechanism. (6%)
3. The principle of superposition has been used widely in the circuit analysis. Please explain briefly regarding the principle of superposition using in the circuit analysis. (4%)
4. For a p-n junction under reverse bias, there is a non-zero current flow (the saturation current I_s at large enough bias). What is the physical origin of this current? (6%)
5. The bipolar junction transistors can perfom two functions that are fundamental to the electronic circuits: amplification and switching. As the consequence, the understanding of the fundamental current components within the bipolar junction transistor should be clear. Please draw the schematic of BJT and explain its current components under the active bias situation. (8%)

二、計算題 (70%)

1. (10%)The circuit shown in Figure 1 is in the form of what is known as a differential amplifier. Find the *expression for v_0 in terms of v_1 and v_2. Assuem that the voltage sources v_1 and v_2 do not source any* current.

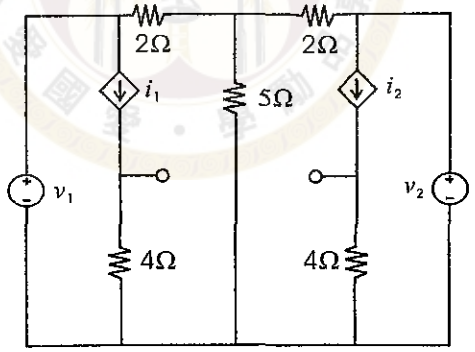

Figure 1

2. (20%) Assume DC steady-state conditionsexist in thecircuit shown in Figure 2 for $t < 0$. The switch is changed at $t = 0$. Please determine:
   (a) $v(t)$ for $t > 0$;
   (b) The time required, after $t = 0$, for $V(t)$ to change by 98% of its totla change in voltage.
   In the figure, $V_{S1} = 17V$; $V_{S2} = 11V$; $R_1 = 14k\Omega$; $R_2 = 13k\Omega$; $R_3 = 14k\Omega$; C = 70nF

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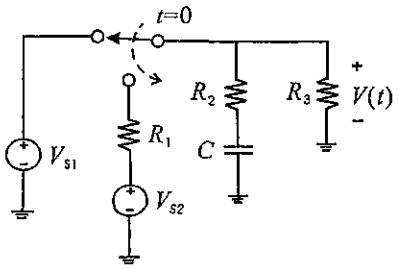

Figure 2

3. (20%) Calculate the transfer function of the circuit shown in Figure 3.
   (a) if $A_0 = \infty$, what choice of the passive components reduces $|V_{out}/V_{in}|$ to unity at specific frequencies?
   (b) if $A_0 < \infty$, is it possible to choose the resistors and capacitors so as to reduce $|V_{out}/V_{in}|$ to approximately unity? Please derive it to explain your answer.

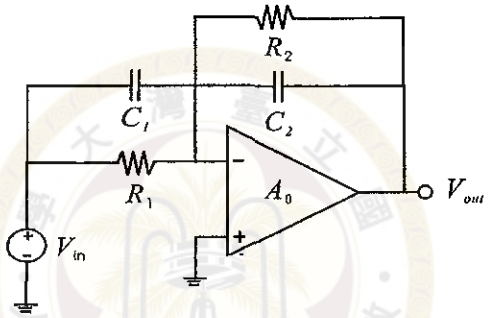

Figure 3

4. (20%) For the circuit in Figure 4, the parameters are given as $V_S = 3$ V, $v_s = 0.1\times\cos(100t)$ V, $R_1 = 2$ kΩ, $R_2 = 1$ kΩ, $R_3 = 2$ kΩ, n =1 (for all diodes), and the capacitors C_1 and C_2 are sufficiently large.
   (a) For $I_0 = 0$ mA, find the total voltage $v_A(t)$ and $v_B(t)$.
   (b) For $I_0 = 1$ mA, find the total voltage $v_A(t)$ and $v_B(t)$.
   [Hint: Please use constant-voltage-drop model with $V_D = 0.7$ V for DC analysis]

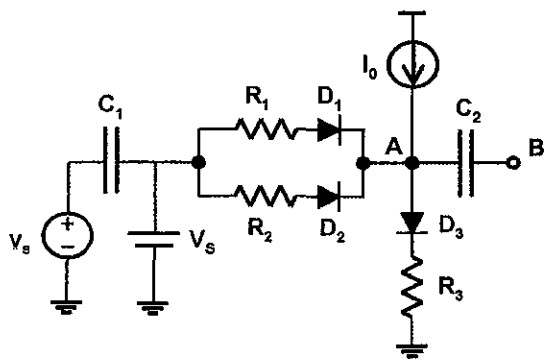

Figure 4

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