《电子电路与系统基础 I》期末考试试题 A 卷

2022.6.13　　学号：　　姓名：

共五大题，卷面满分 100 分。全部题目在答题纸上作答，在本试题纸上作答无效。

一、如图所示电路，受控电流源的输出电流$I_x = g_m v_{be}$，其中v_{be}为C_{be}两端的电压，已知$g_m = 0.05mS$，$R_S = 1k\Omega$，$R_L = 10k\Omega$，$C_{be} = 500pF$，$L_1 = 30mH$，$C_L = 1nF$

1） 求系统的电压传递函数$\mathrm{H(s)} = \frac{v_{out}(s)}{v_s(s)}$

2） 求系统的自由振荡频率ω_0

3） 判断系统的阻尼态

4） 如果在 A、B 两点间加一个电容C_S，使系统处于临界阻尼，求C_S的容值

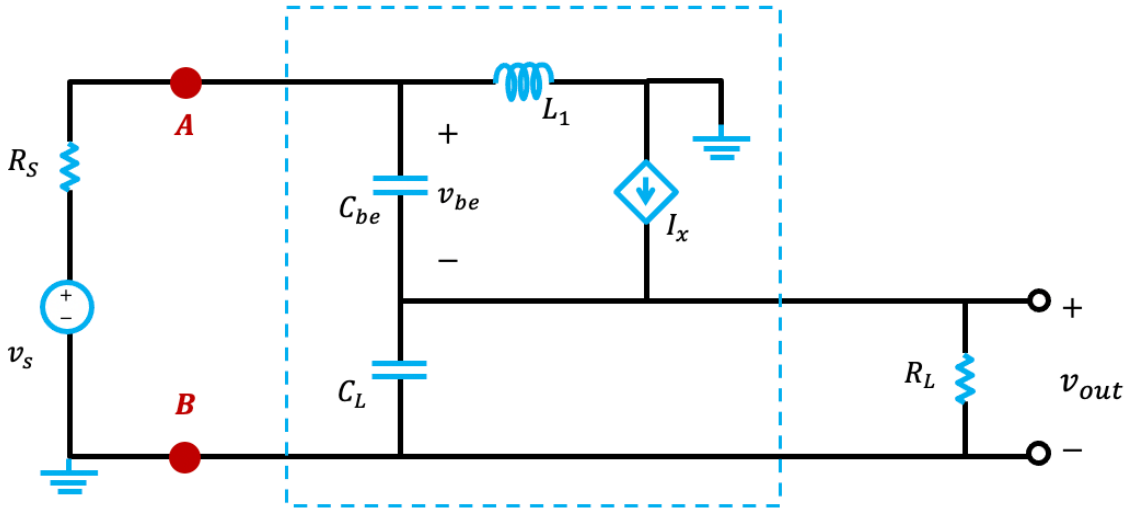
The current of the voltage controlled current source is $I_x = g_m v_{be}$, where v_{be} is the voltage across C_{be}. $g_m = 0.05mS$, $R_s = 1k\Omega$, $R_L = 10k\Omega$, $C_{be} = 500pF$, $L_{bc} = 30mH$, $C_L = 1000pF$.

1) Find the voltage transfer function of the system $\mathrm{H(s)} = \frac{v_{out}(s)}{v_s(s)}$.

2) Find the resonance frequency ω_0 of the system.

3) Find the damping status of the system.

4) If a capacitor C_s is added between A and B, find the C_s that will put the system in the critically damped status.



二、如图所示电路，其中方框内的电路结构未知，已知$R_S = 3\Omega$、$R_L = 1\Omega$, 方框内电路的h参数 $\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 6\Omega & 1 \\ -9 & 3\mathrm{S} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$

1） 求系统的传递函数$H = \frac{v_L}{v_s}$

2） 求从左侧输入端箭头看进去的等效输入阻抗

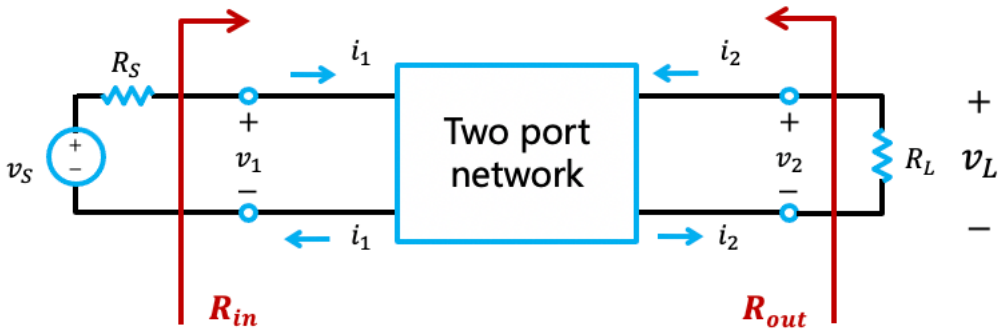
3） 求从右侧输入端箭头看进去的等效输出阻抗

The circuit structure in the box is unknown with a h parameter of $\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 6\Omega & 1 \\ -9 & 3\mathrm{S} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$. $R_S = 3\Omega$, $R_L = 1\Omega$.

1) Find the transfer function of the system $H = \frac{v_L}{v_s}$.

2) Find the equivalent input impedance seen from the left arrow.

3) Find the equivalent output impedance seen from the right arrow.



三、图 3.1 所示为受控开关，当控制信号S_{ctrl}为 V_{H}时，A、B 两点导通，导通电阻为 0；当控制信号S_{ctrl}为 V_{L}时，A、B 两点断开。

1） 如图 3.2 所示，A_1为非理想运算放大器，画出非理想运算放大器电压转移特性示意图

2） 画出运算放大器在线性区的等效电路

3） 已知两个电容上无初始储能，写出图 3.2 所示电路的系统传递函数$H = \frac{v_{out}}{v_{in}}$

4） 如图 3.3 所示，A_2为理想运算放大器，画出输出电压v_{out}与v_{in}的关系

（注：只画图没有分析过程不得分）

Figure 3.1 shows a controlled switch. The switch is turned on with $r_{AB} = 0$, when the control signal S_{ctrl} is V_H. The switch is turned off with $r_{AB} = \infty$, when the control signal S_{ctrl} is V_L.

1) As shown in Figure 3.2, A_1 is a non-ideal operational amplifier. Draw a schematic diagram of the voltage transfer characteristics of the non-ideal operational amplifier

2) Draw the equivalent circuit of the operational amplifier in the linear region

3) There is no energy storage on the two capacitors at $t = 0$. Find the system transfer function $H = \frac{V_{out}}{V_{in}}$ of the circuit shown in Figure 3.2

4) As shown in Figure 3.3, A_2 is an ideal operational amplifier, draw the relationship between the output voltage V_{out} and V_{in}

(Note: zero score if drawing without analysis)

图 3.1

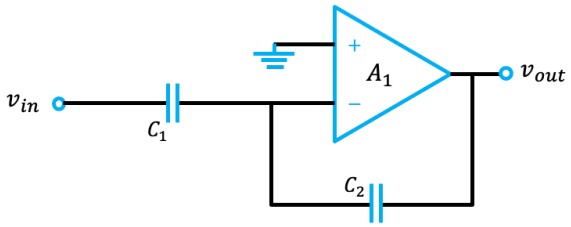


图 3.2

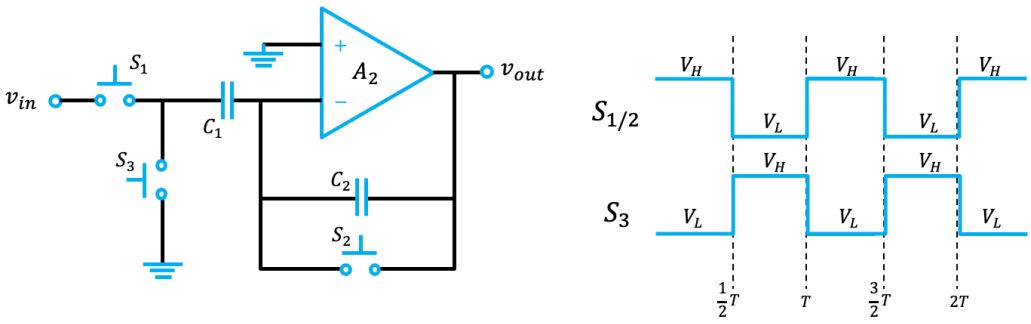
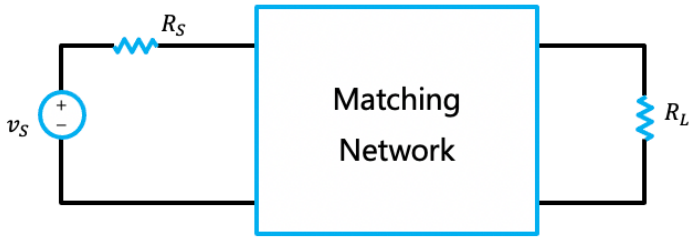


图 3.3

四、如图所示电路，框中为匹配电路，电路拓扑未知，已知$R_S = 50\Omega$、$R_L = 10k\Omega$，当$f_0 = 70MHz$时负载R_L上达到最大功率输出，设计满足此要求的匹配电路

The matching network circuit is unknown. R_s = 50Ω, R_L = 10$k\Omega$. The system reaches its maximum power output on the load resistor R_L when f_0 = 70MHz. Design a proper matching network to meet this requirement.



五、根据下图所示系统幅频特性和相频特性，写出该系统的传递函数表达式

According to the amplitude-frequency and the phase-frequency characteristics of the system shown below, find the transfer function of this system.