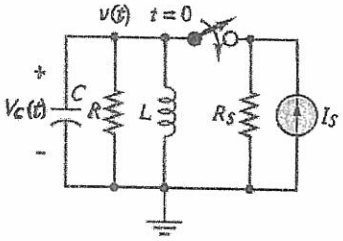
國立臺灣大學99學年度碩士班招生考試試題

1. Problem 1 (15%)

a) Please derive the differential equation of this circuit to a generalized form. (5%)

b) Please find natural frequency (unit in rad/s) and damping ratio if I_s=5A; R=500 ohm; C=2μF; L=2H (5%)

c) Please write the complete solution of $V_c(t)$ (5%)

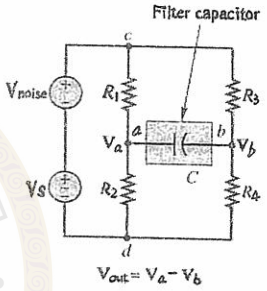


2. Problem 2 (25%)

a. Please convert the right circuits to a Thevenin equivalent circuit if R_1= R_2= R_3= R_4=350 ohm, find out the Thevenin equivalent resistance and the Thevenin voltage (10%)

b. What is the purpose to put a capacitor in between node a and b? (5%)

c. If we want to design a filter with a cutoff frequency of 300Hz, what is the value of capacitor C should we choose? (10%)



3. Problem 3, v_{s1}=37.2mV; v_{s2}= 40.2 mV; R_1= R_3= R_4=5K ohm; R_2=3K ohm; R_L=600 ohm (25%)

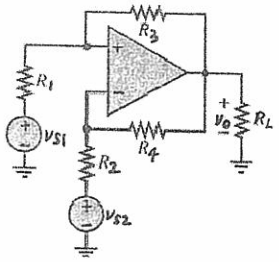
a. The voltage gains for the two input voltages. (8%)

b. The common-mode and differential-mode input voltages. (4%)

c. The common-mode and differential-mode gains. (4%)

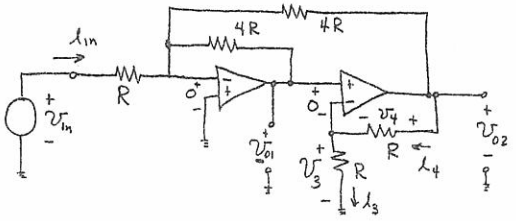
d. The common-mode component and the differential-mode component of the output voltage. (4%)

e. The CMRR in decibels. (5%)



4. Problem 4. (10%)

Please derive the expressions for the voltage gain A_1=v_{01}/v_{in} and A_2=v_{02}/v_{in} (10%)



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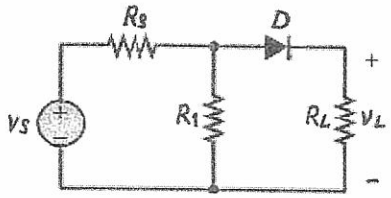
5. Problem 5 (10%)



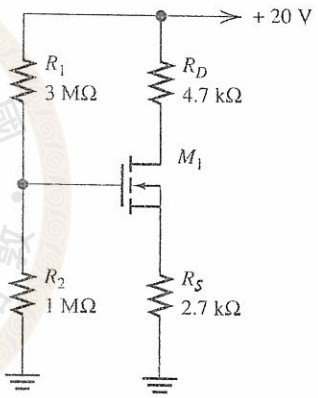
a. Find the transfer function of this circuit. (5%)

b. Plot the v_L vs. v_s, please indicate the slope and phase in your plot. (5%)

6. Problem 6 (15%)

a. Please draw the cross section of an NMOS with the bias configuration. (5%)

b. Please draw the I_D vs. V_{DS} curve of an NMOS and indicate the different regions. Please also write the drain current equations at different regions. Please indicate the meaning of your variables in your drain current equations. (5%)



c. Please analyze the circuit in the right hand side. If $K=1mA/V^2$; $Vt=2V$ (Threshold voltage); $V_{DD}=20V$; what are drain current and V_{DS} at operation point? (5%)

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