İTÜ-EEF ANALOG ELECTRONIC CIRCUITS 2015

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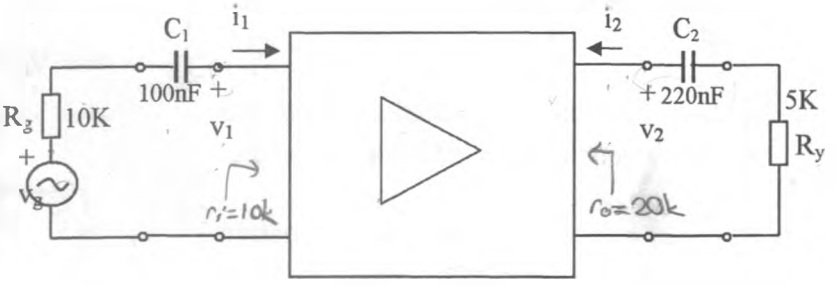
FINAL EXAM Jan. 11, 2016

1)-

a)- For the given circuit at midband frequencies, v_2/v_g=-50, amplifier input resistance r_i=10kΩ & output resistance r_o=20kΩ. Find the transfer conductance i_2/v_1.

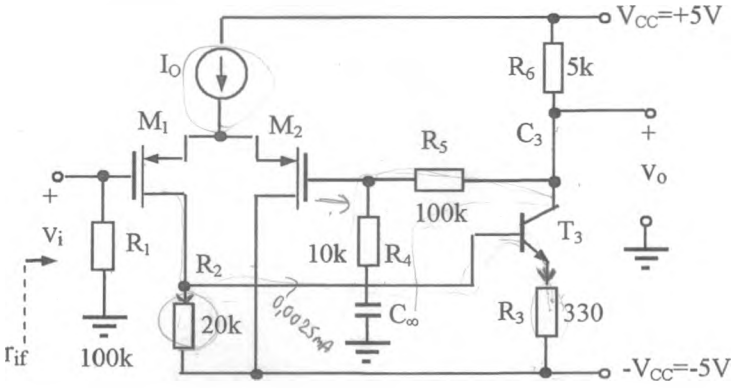


b)- The circuit has three poles and one zero at the low frequencies. What can you say about the amplifier ? If the poles and zeroes are at: f_{k1}=79.58Hz, f_{k2}=28.94Hz, f_{k3}=10.6Hz, and f_0=2.12Hz, associate each criticial frequency with a capacitor.

c)- For what value of C_2 will this circuit have only two poles? For this value of C_2, draw the low+mid frequency range Bode diagrams for v_2/v_g.

d)- If the amplifier has C_{in}=20pF (input C), C_{out}=2pF (output C), and C_r=0.5pF (feedback C), calculate the high frequency poles and the high cutoff frequency of the circuit.

e)- How would you obtain the frequency response of an amplifier in the lab? How can you determine the low and high frequency cutoffs? Draw a measurement schematic showing the necessary equipment and connections (show the amp. as a 2-port).



M_1, M_2 (PMOS) :
V_{TP}= -0.6V, β=10mA/V²
$g_{m1}=g_{m2}=\sqrt{\beta I_O}$
T_3 :
kT/q=25mV, β_F=400, V_{BE}=0.62V

2)- For the circuit given above:

a)- Find I_0 to obtain V_{C3}=0V in the quiscent state.

b)- Design a current mirror using 2 active devices and one resistor to provide I_0 . Find the value of this resistor to get the I_0 value that you found in part (a).

c)- What is the feedback topology? Why? Identify the feedback circuit.

d)- Find the open loop voltage gain of the circuit including the loading effect of the feedback circuit.

e)- Find the closed loop voltage gain v_o/v_i.

f)- If the voltage gain v_o/v_g =7, find the source resistance of the generator connected to the input.

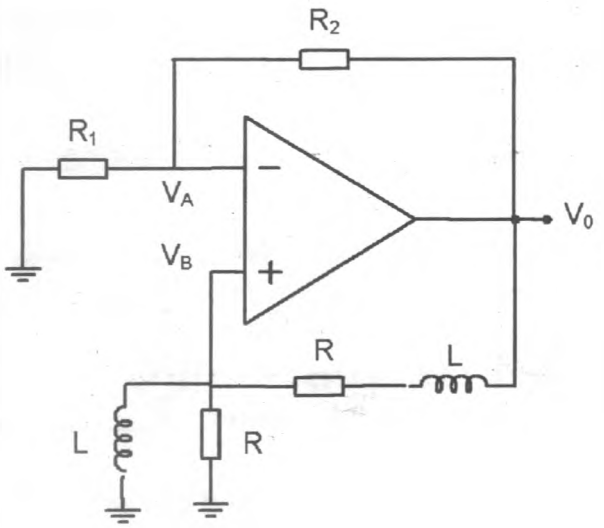
CONTINUED ON THE BACK- TURN OVER ☞

3)- The amplifier in the given oscillator circuit is an ideal operational amplifier.

a)- Find the transfer function of the passive RL circuit $H(s)=V_B(s) / V_o(s)$

b)- Write the condition of oscillation. Find the frequency of oscillation in terms of R and L.

c)- Find the gain condition for sustained constant amplitude oscillations at the output in terms of R_2 and R_1.



Points: 36+ 36+ 28=100 **Time 120".**

Notes: Closed books & notes. No cellphones. No formula sheets. You may make reasonable engineering approximations. All your approximations, roundings, and assumptions should be clearly visible. Be careful with your units.

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