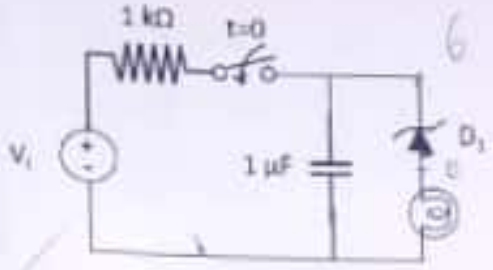
EE 101: Introduction to Electrical and Electronic Circuits, 2019

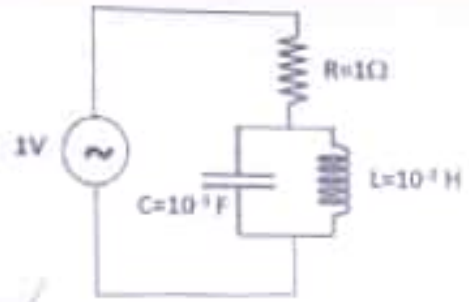
Endsem

(Show all the steps in the solution properly. Weightage=50.5 %)

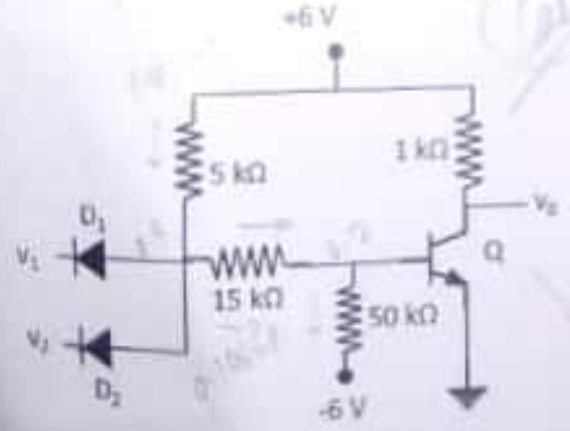
1) Consider the circuit below with a Zener diode (forward bias voltage drop=0.7 V and breakdown voltage of 6V). The bulb has a neglible resistance and does not glow when the current through it is zero. If the switch closes at t=0, find out the time at which the bulb may glow. Calculate the steady state capacitor voltage when a) V_i=8 V b) V_i=4 V and c) V_i=8 V. [6 marks]



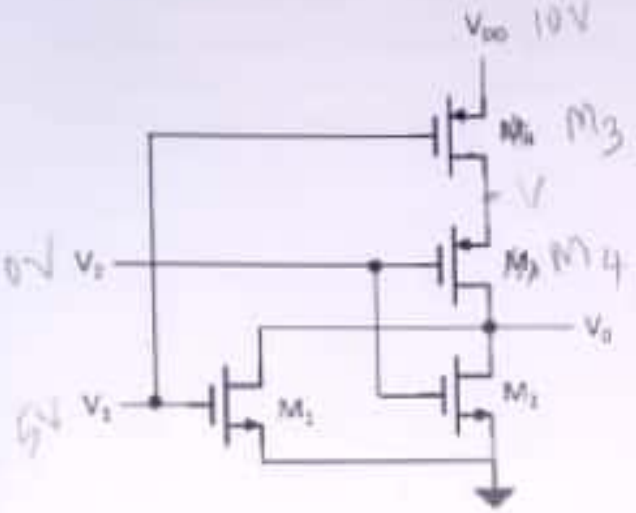
2) Consider the circuit shown below. Find out the transfer function h(ω). (h=V_R/V_{in}). Sketch the real and imaginary parts of h as a function of ω. [6 marks]



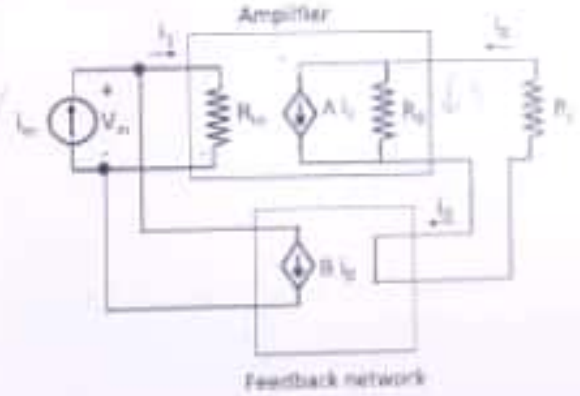
3) Consider logic circuit as shown below. Assume ON voltage of diode to be 0.7 V. Assume V_{high}=6V and V_{low}=0.2 V. Show that the circuit works as a NAND gate. Find out the fan out. (Given β=100). [8 marks]



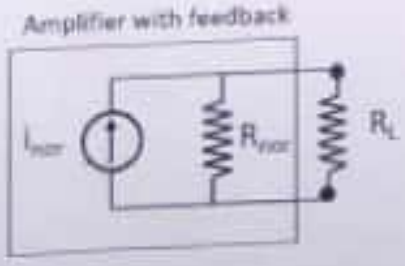
4) Find out the output of the CMOS circuit when V_1= 5 V and V_2= 0 V. Given V_{DD}=10 V, K=0.25 mA/V^2 and the threshold voltages for M_1 and M_2 are 1 V, whereas the threshold voltages for M_3 and M_4 are -1 V. Assume M_1 , M_3 in active region, M_4 in ohmic region. Verify the assumptions. [8 marks]



5) Consider a current amplifier with feedback network as shown below. Assuming R_L=0, find out the input resistance (V_{in}/i_{in}) and loop gain (i_0/i_{in}) in terms of parameters A and B.

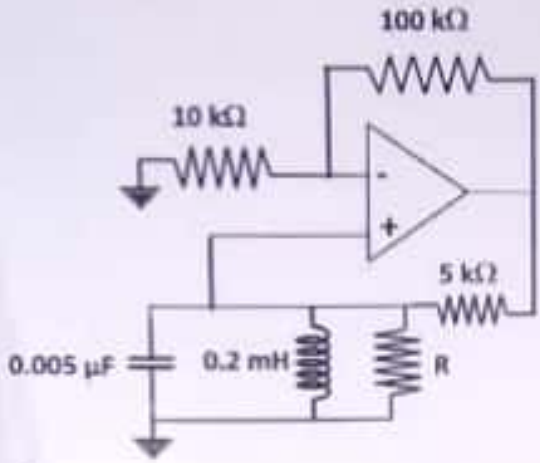


Now assume a general load resistance R_L. What is the input resistance now?
Find out the i_{nor} and R_{nor} of the Norton equivalent circuit of the amplifier output as shown below.



[8 marks]

6) For the oscillator circuit shown below, assume that the op-amp is ideal. Find out the frequency of oscillation. Find out the minimum value of R for which oscillations occurs. [7 marks]



7) Consider common emitter amplifier as shown below. Assume that the capacitors can be replaced by short circuits for the ac part of the circuit. The small signal model of the BJT is shown on the right side. Using this small signal model, find out the expressions for ac voltage gain $A_v=v_o/v_b$, $A_{vs}=v_o/v_s$ and the ac input resistance, R_{in}.

Find out the numerical values of A_v and R_{in} assuming, $R_1=R_2=20$ kΩ, $R_C=R_L=2$ kΩ, $g_m=0.08$ Ω^{-1}, $r_o=450$ kΩ, $r_\pi=1.3$ kΩ and $r_\mu=13$ MΩ.

[8 marks]