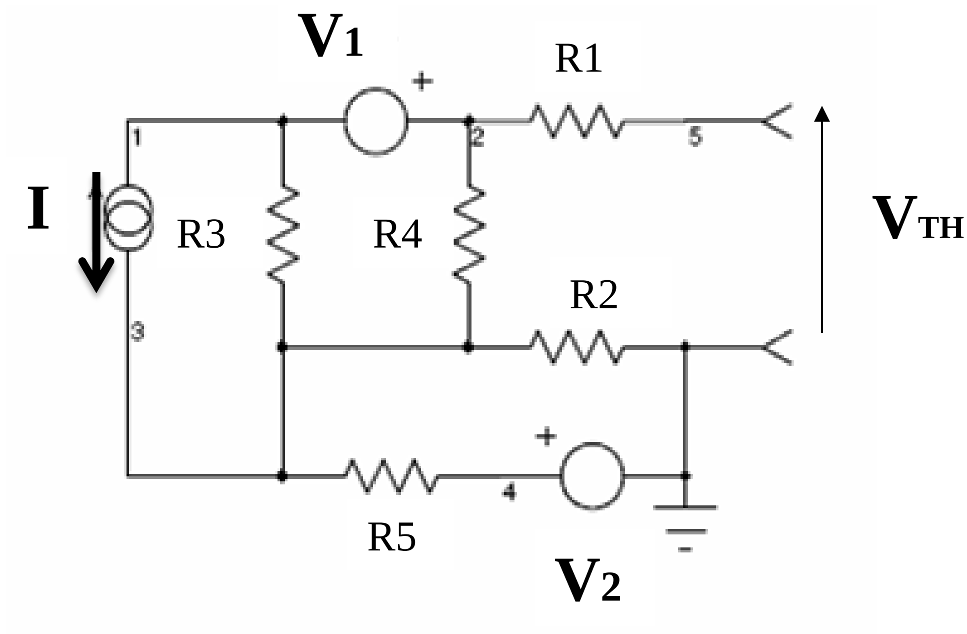
Re-Exam Electronics
11-05-2015
Prof. Dr. G. Palasantzas
Maximum score: 10

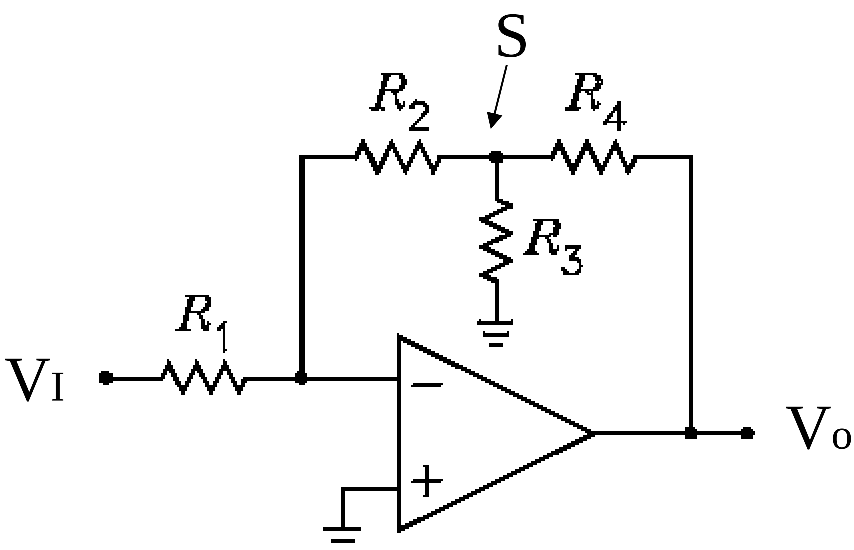
Problem 1 (2 points)



For the circuit above give the corresponding Thevenin equivalent parameters V_{TH} (1.5 point) and R_{TH} (0.5 points) [use only the Thevenin-Norton concepts for your computations]

Problem 2 (1.5 points)

T-feedback system: Ideal opamp

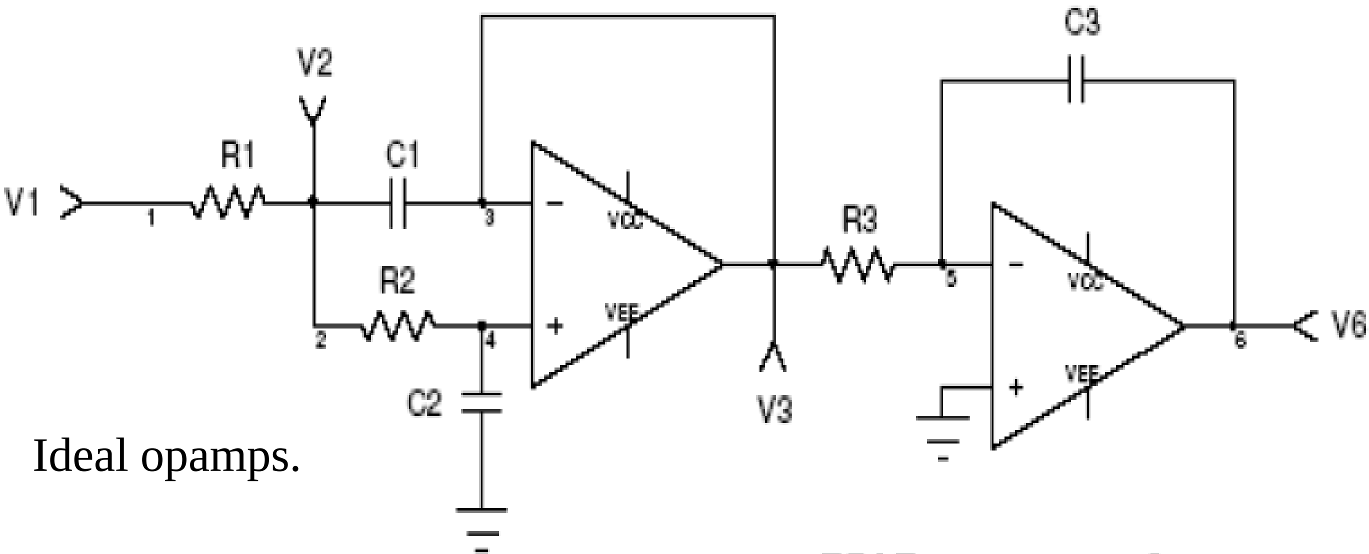


Prove that the output voltage Vo is given by:

$$\frac{V_o}{V_I} = -\left[\frac{R_2}{R_1} + \frac{R_4}{R_1}\left(1 + \frac{R_2}{R_3}\right)\right]$$

Problem 3 (2 points)

Consider the oscillator circuit:



Ideal opamps.

(a: 0.5 points) Prove:

$$\frac{V(6)}{V(3)} = -\frac{1}{j\omega\tau_3}$$

$\tau_3 = R_3C_3.$

(b: 1 point) Prove:

$$V(2) = \frac{\left(\frac{R_1}{R_2} + j\omega\tau_1\right) V(3) + V(1)}{1 + \frac{R_1}{R_2} + j\omega\tau_1}$$

$\tau_1 = R_1C_1.$

(c: 0.5 points) Prove:

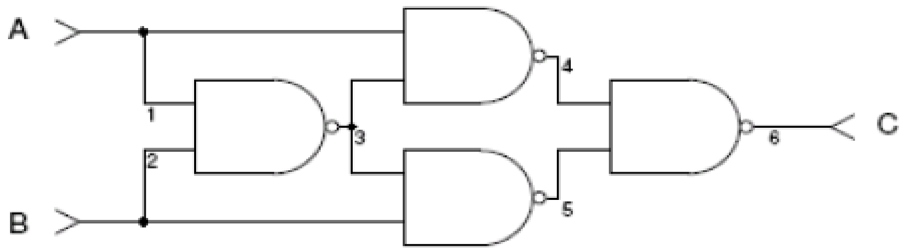
$$V(3) = V(4) = \frac{V(2)}{1 + j\omega\tau_2}$$

$\tau_2 = R_2C_2.$

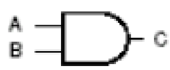
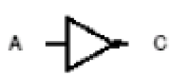
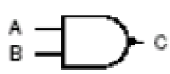
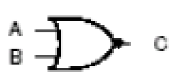
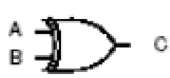
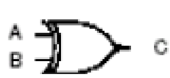
Problem 4 (2 points)

(a) (0.5 point)

Is the logic system bellow shown a realization of a logic gate XOR?

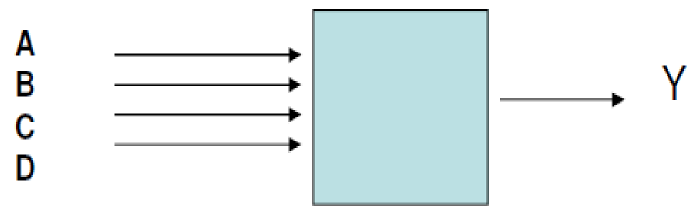


Useful logic gates:

AND		$C = A \cdot B$	A B C 0 0 0 0 1 0 1 0 0 1 1 1
OR		$C = A \times B$	A B C 0 0 0 0 1 1 1 0 1
NOT		$B = \overline{A}$	A B 0 1 1 0
NAND		$C = \overline{A \cdot B}$	A B C 0 0 1 0 1 1 1 0 1
NOR		$C = \overline{A \times B}$	A B C 0 0 1 0 1 0 1 0 0
XOR		$C = A \oplus B$	A B C 0 0 0 0 1 1 1 0 1
XNOR		$C = \overline{A \oplus B}$	A B C 0 0 1 0 1 0 1 0 0

(b) (1.5 points)

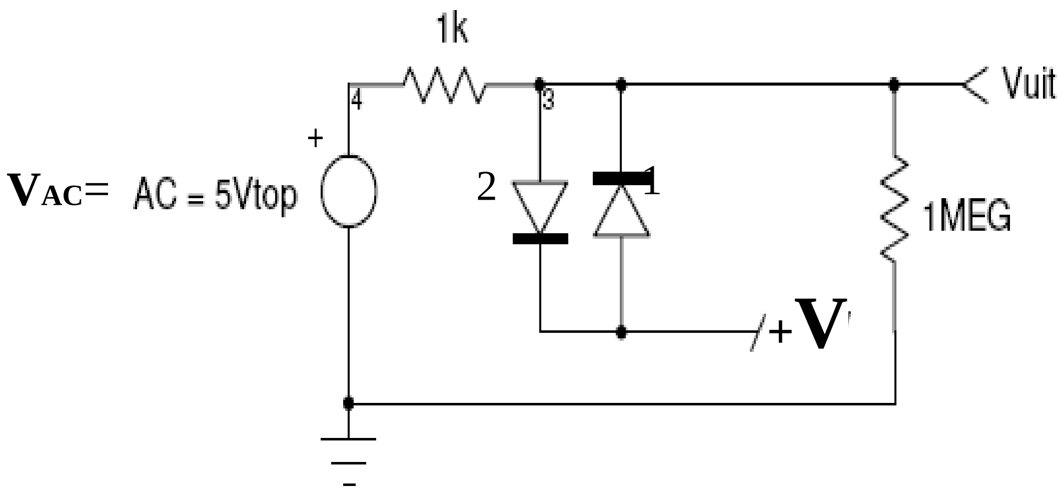
Design a transformer that takes a 4-bit number ABCD and gives a single output Y true (Y=1) if and only if this is prime number



Decimal	ABCD	Y
0	0000	
1	0001	
2	0010	
3	0011	
4	0100	
5	0101	
6	0110	
7	0111	
8	1000	
9	1001	
10	1010	
11	1011	
12	1100	
13	1101	
14	1110	
15	1111	

Problem 5 (1 point)

Assume that $V + V_C < V_{AC}$



Consider Vc=0.5 V (diode voltage for forward conduction) and V=3 V

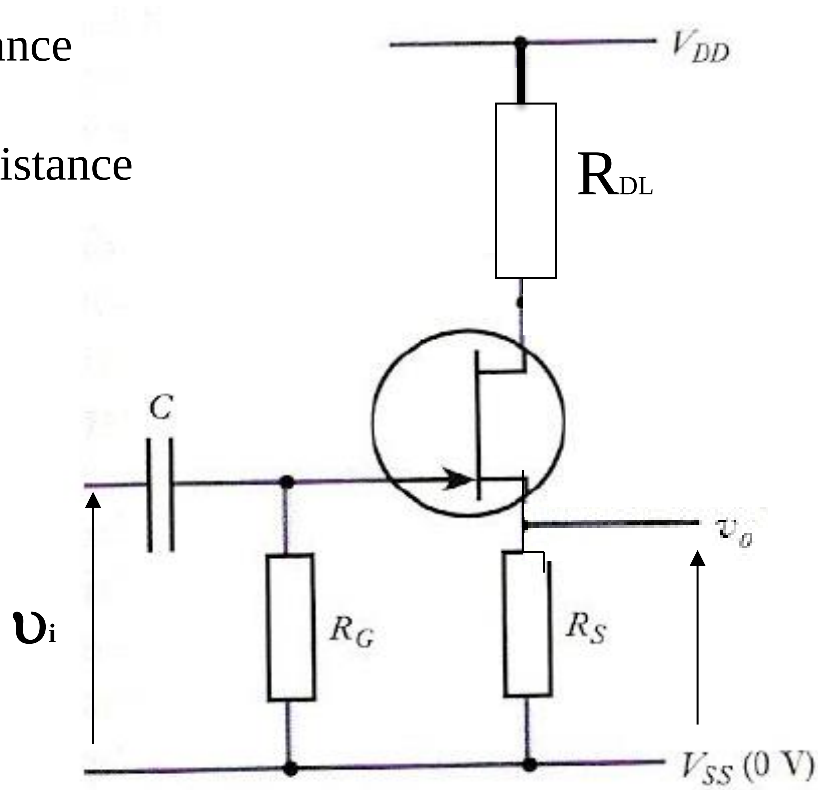
Draw the output voltage Vuit and explain briefly why.

Problem 6 (1.5 point)

Consider the FET amplifier circuit shown bellow:

g_m=transconductance

r_d: Differential resistance



Show that the amplification ratio is given by:

$$\upsilon_o/\upsilon_i = g_m(R_s)/[1 + g_m R_s + (R_s + R_{DL})/r_d]$$