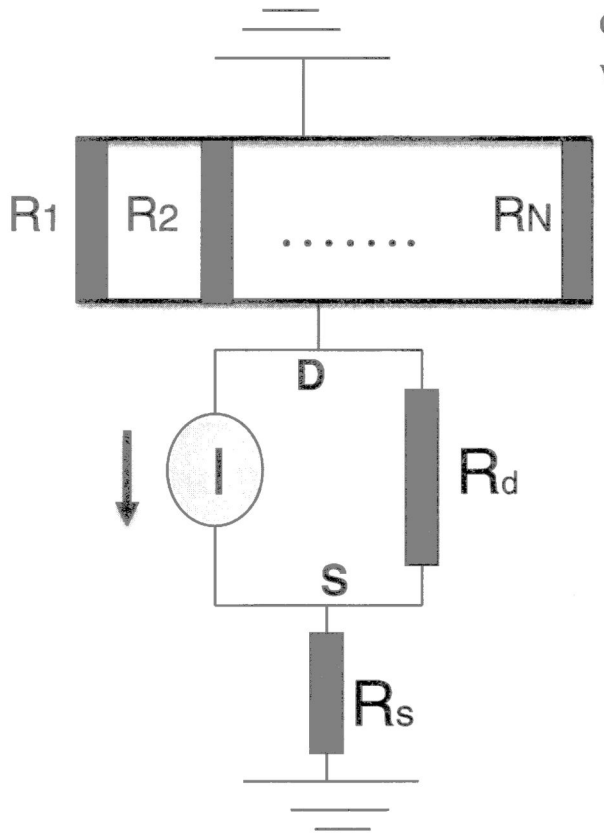
Final exam
Electronics & Signal processing
11-04-2017
Prof. Dr. G. Palasantzas

Grade of written exam:
Mark is thecummulative points scored for all problems
Total maximum score : 10

Problem 1 (1.5 points)

Consider the current source I in the circuit shown below to be parallel with a resistor R_d

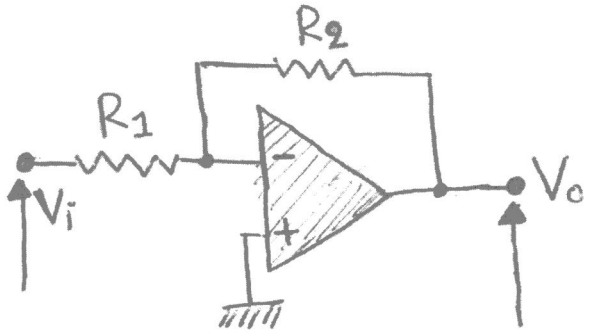


(a: 1 point) Calculate the potential at point D

(b: 1/2 points) Calculate the current through each resistance Ri, i={1,N}

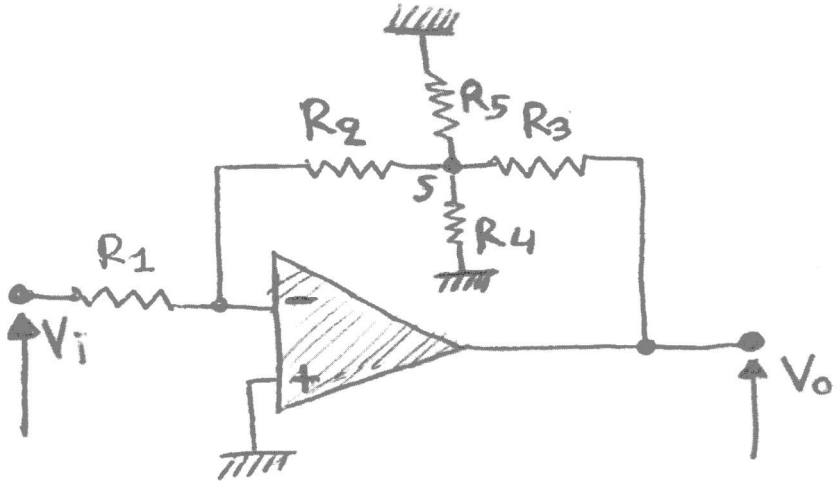
Problem 2 (2.5 points)

(a: 1 point) Consider the opamp to have infinite input and zero output resistance, but finite forward open loop gain A so that Vo=A(V+ - V-)



(a1: 1/2 points) Calculate the closed loop gain Vo/Vi
(a2:: 1/2 points) Calculate the limit of Vo/Vi for an ideal opamp with A→+∞

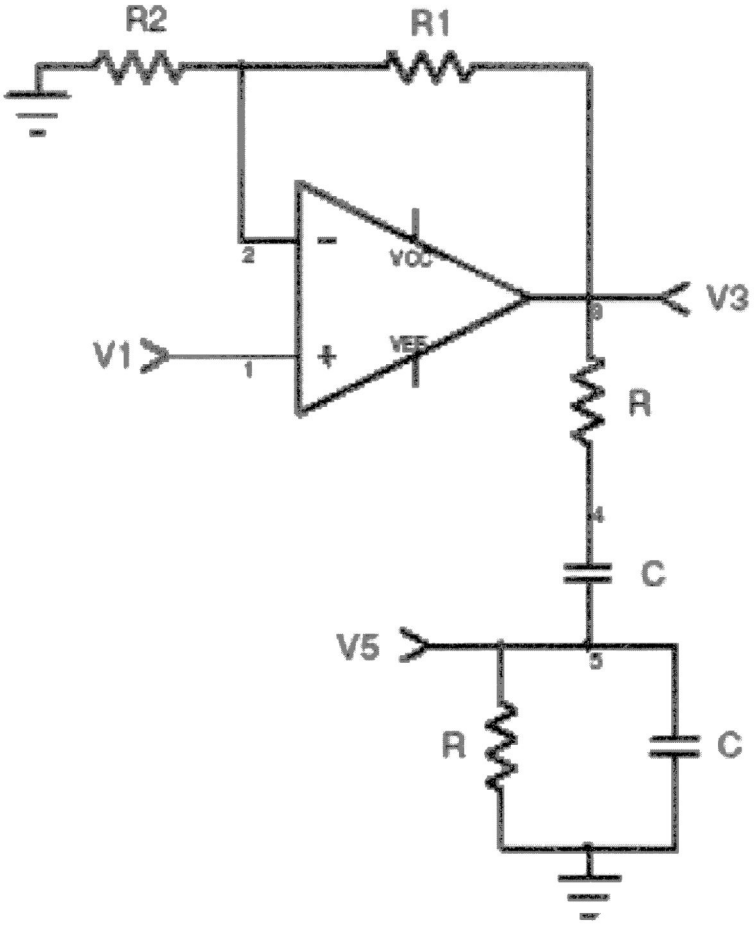
(b: 1.5 points) Consider the opamp to be ideal with infinite input and zero output resistance, and infinite forward open loop gain (A=+∞) so that V+=V-



(b1: 1/2 points) Calculate the potential at point S
(b2: 1 point) Calculate the closed loop gain Vo/Vi

Problem 3 (1.5 points)

Consider the oscillating circuit (Wien Oscillator) with V+=V-

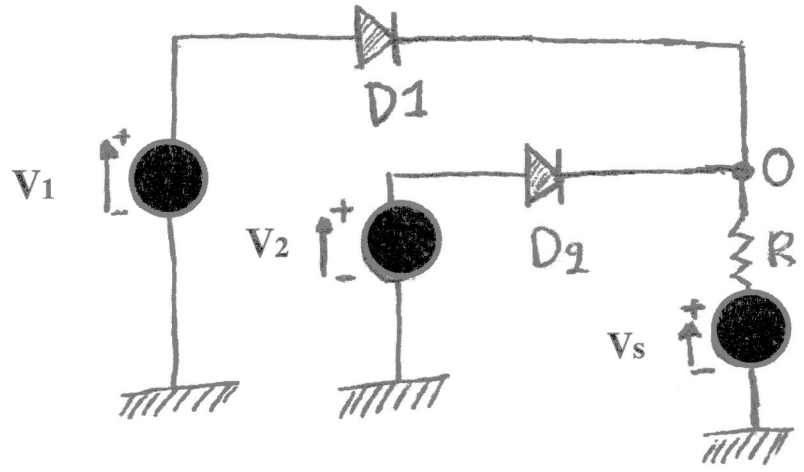


(a: 1/2 points) Calculate the transfer A = V(3) / V(1)

(b: 1/2 points) Calculate the transfer B = V(5) / V(3). For what value of ωRC is B real?

(c: 1/2 points) For what value of R_1 / R_2 is AB = 1? Note that now V(5) = V(1).

Problem 4 (1.5 points)



(a: 1/2 point) The diodes D1 and D2 are ideal with forward conduction voltage Vc=0.7 V. Explain briefly which diode conducts current, and justify your answer. Consider V_1=4 V, V_2=9 V, and Vs=2 V

(b: 1/2 point) Calculate the current via the resistor R.

(c: 1/2 points) How much power is consumed on the diode that conducts current?

Problem 5 (1.5 points)

Design a synchronous 4-counter using J-K flip-flops that counts through the states 1, 2, 3, 4:

	Before state			After state		
	Q3	Q2	Q1	Q3	Q2	Q1
1	0	0	1			
2	0	1	0			
3	0	1	1			
4	1	0	0			

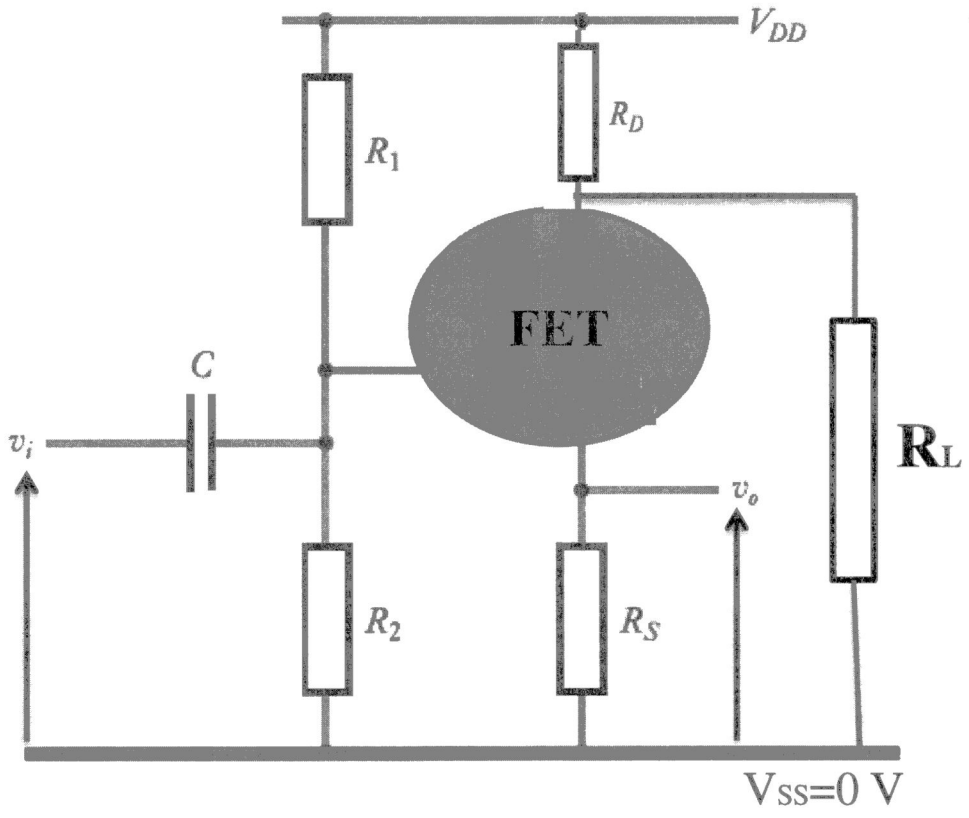
Q_{n-1}	Q_n	J	K
0	0	0	*
0	1	1	*
1	0	*	1
1	1	*	0

*: don't care

J	K	Q_n
0	0	Q_{n-1}
0	1	0
1	0	1
1	1	$\overline{Q_{n-1}}$

Problem 6 (1.5 points)

Consider a FET as shown bellow:



Show that the amplification ratio υ_o / υ_i of the small voltage variation at the input/output is given by:

$$\frac{\upsilon_o}{\upsilon_i} = \frac{g_m R_s}{1 + g_m R_S + [(R_{DL} + R_S)/r_d]}, \quad R_{DL} = R_D // R_L$$

with g_m the transconductance, and r_d the differential resistance of the FET operating at saturation.