Written exam
IE1206 Embedded Electronics
IF1330 Electrical principles
Monday 3/6 2019 14.00-18.00

General Information

Examiner: Carl-Mikael Zetterling

Responsible teacher at exam: Per-Erik Hellström 08-790 43 25

All sheets that are handed in need **your name and personal number** written on them.
Mark every sheet with the **problem it deals** with.
You cannot have more than one problem per sheet.

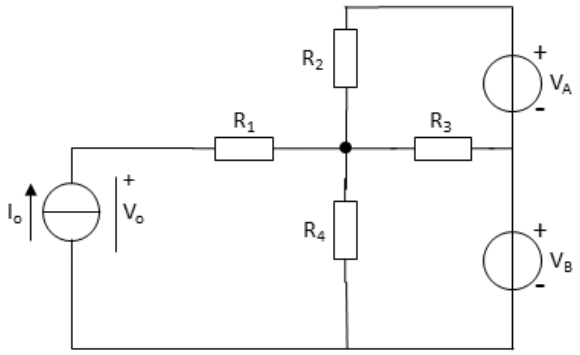
Aids: Calculator

The exam consists of 8 problems (5 points each) distributed over the 4 modules in the course:
Module 1: problem 1 and 2
Module 2: problem 3 and 4
Module 3: problem 5 and 6
Module 4: problem 7 and 8

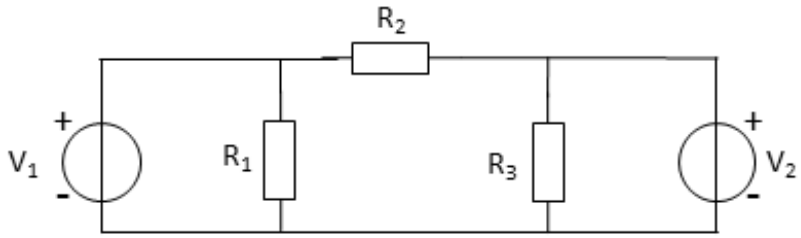
To **pass the exam** requires at least **2 points** from each module and preliminary **20 points** in total.
Grades are given as follows:

Points	<20	20-23	24-27	28-31	32-35	36-40
Grades	F	E	D	C	B	A

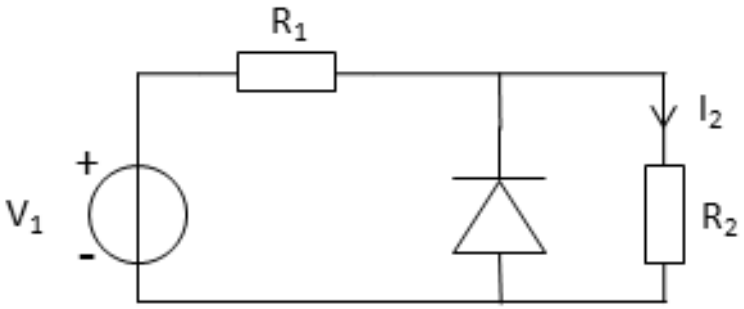
1. Determine the voltage V_o over the current source.
   R_1=1 kΩ, R_2=3 kΩ, R_3=2 kΩ, R_4=6 kΩ, I_o=1 mA, V_A=1 V, V_B=5 V.



2. V_1=2 V, V_2=4 V, R_1=2 kΩ, R_2= 8 kΩ, R_3= 4 kΩ.
   (A) Determine the power consumed in R_2.
   (B) What is the total power delivered by the voltage sources to the resistors?



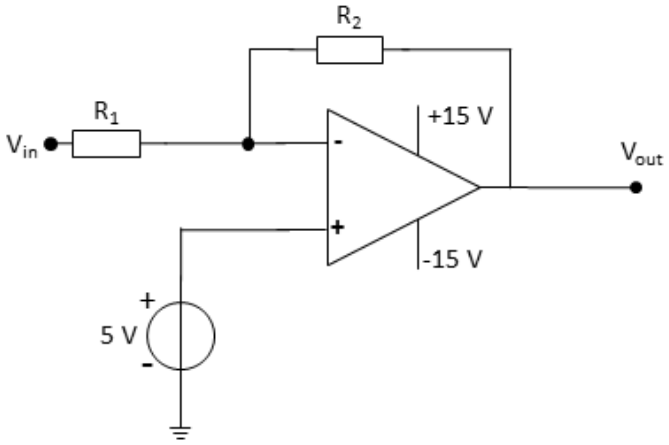
3. Determine the current I_2. V_1=4 V, R_1=10 kΩ and R_2=30 kΩ.



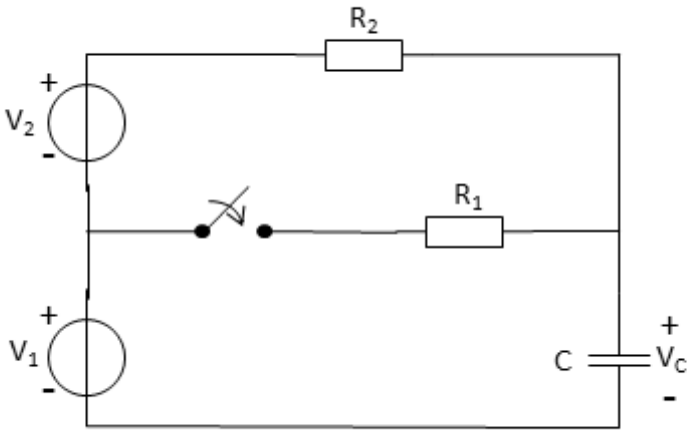
4. Assume that the operational amplifier is ideal.

   (A) Express V_{out} as function of V_{in}, R_1 and R_2 when the operational amplifier works in the linear region.

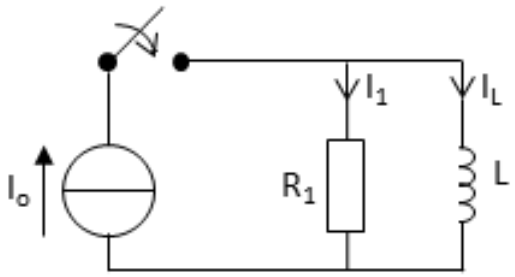
   (B) Plot V_{out} versus V_{in} for -15 V < V_{in} < +15 V when $\frac{R_2}{R_1} = 2$.



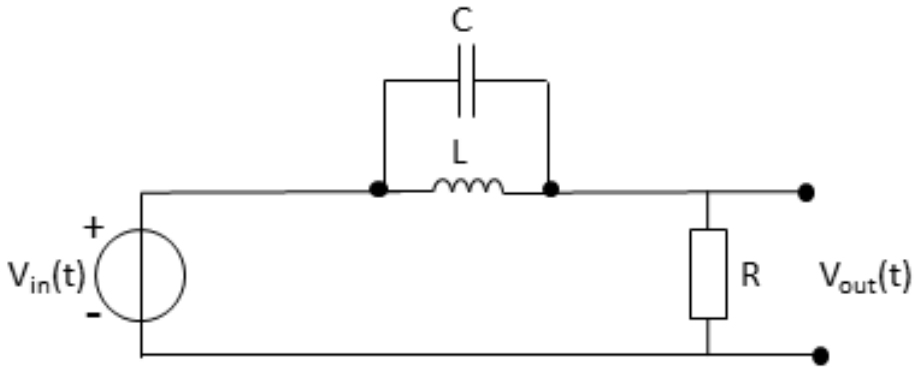
5. The switch has been open for a long time. At t=0 s the switch closes. Determine the voltage V_c over the capacitor at t=6 µs. V_1=1 V, V_2=6 V, R_1=10 kΩ, R_2=15 kΩ and C=1 nF.



6. The switch has been open for a long time. At t=0 s the switch closes.
   (A) Derive an expression for the current I_1 as a function I_o, R_1, L and t.
   (B) Plot $I_1(t)$ for -3 μs < t < 3 μs when R_1=1 kΩ, L=1 mH, I_o=1 mA.



7. $v_{in}(t)$ is a steady-state cosine voltage source with amplitude A, angular frequency ω and phase angle ϕ.
   (A) Determine v_{out} when the angular frequency $\omega = \frac{1}{\sqrt{LC}}$.
   (B) What type of filter function does the circuit perform? Motivate your answer.



8. Determine the Thévenin equivalent circuit seen at A-B.
   Draw a schematic of the Thévenin equivalent circuit and express all parameters in the time domain when ω=1000 rad/s.