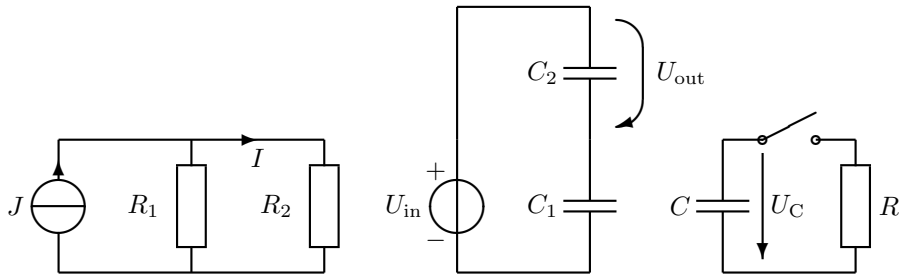
Answer all four questions!



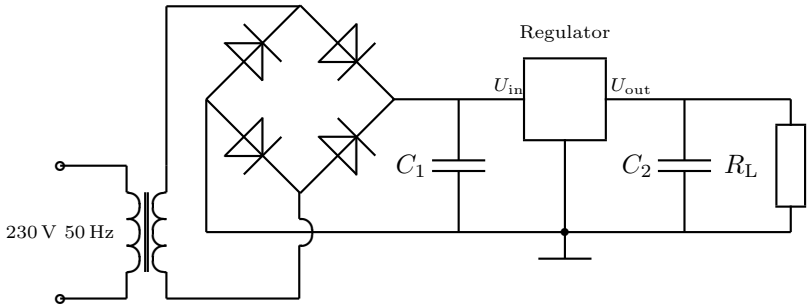
Assignment 1

Find the current I (3 points), the transfer function $F(s) = \frac{U_{\text{out}}}{U_{\text{in}}}$ (3 points) and the voltage $U_{\text{C}}(t)$, when the switch is closed at time $t = 0$ (4 points). The component values are

$J = 1\,\text{mA} \quad R_1 = 3\,\text{k}\Omega \quad R_2 = 6\,\text{k}\Omega \quad C_1 = C_2 = 10\,\text{nF} \quad C = 100\,\mu\text{F} \quad R = 100\,\text{k}\Omega$

and the initial voltage of the capacitor C is $U_{\text{C}}(0) = 10\,\text{V}$.

Assignment 2

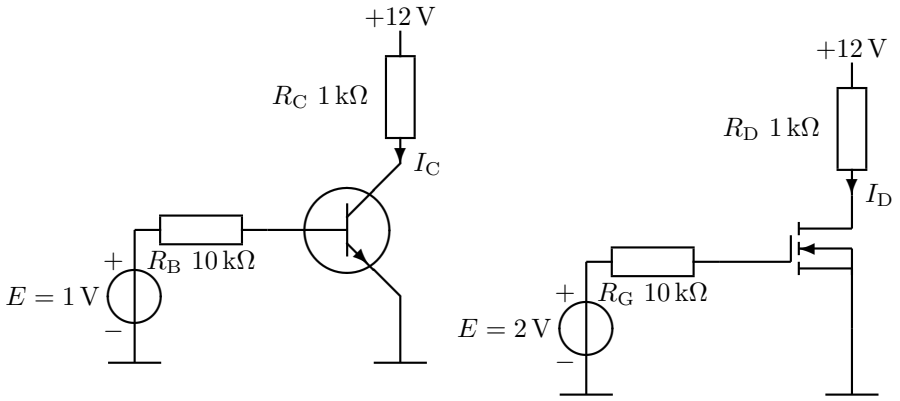


The input voltage of the regulator can vary between $8\,\text{V} \ldots 15\,\text{V}$. The current taken by the load and the regulator is 500 mA. Calculate the value for the capacitor C_1 (5 points) and the maximum reverse voltage for diodes U_{reverse} (3 points). Calculate also the rms value for the output voltage of the transformer (2 points).

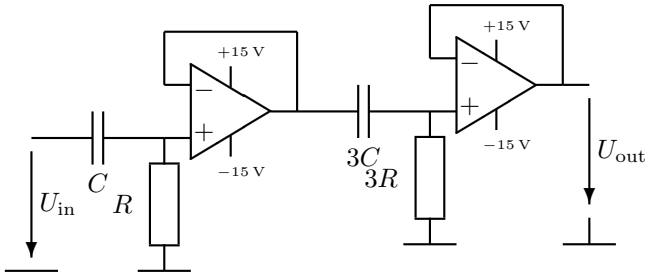
Bonus question (2 points): find the maximum current through the diodes in the rectifier bridge.

Assignment 3

a) Draw a circuit diagram for a circuit which fulfills the function $U_{\text{out}} = 2U_{\text{in}}$ (3 points).



b) Find the current I_C (3 points). The current gain of the transistor is $\beta = 100$.
c) Find the current I_D. For the MOSFET: $U_T = 3\,\text{V}$ and $K = 50\,\frac{\text{mA}}{\text{V}^2}$ (3 points).
d) If the collector resistor R_C were 100 kΩ, how large is I_C? (1 point)



Assignment 4

a) Is the circuit a low-pass or a high-pass filter (1 points)? Calculate the transfer function for the circuit (3 points), find the characteristic frequency f_0 (2 points) and the damping coefficient D (2 points).

b) A transfer function for a Bessel filter is

$$F(s) = \frac{3}{s^2 + 3s + 3}.$$

Using this function, design a 2nd order Bessel low-pass filter, for which the half-power frequency is at $\omega = 10$. Calculate the characteristic angular frequency ω_0 (1 point) and the damping coefficient D for the filter (1 point).

Bonus question (2 points): Draw the circuit diagram (with component values) for the filter you designed.