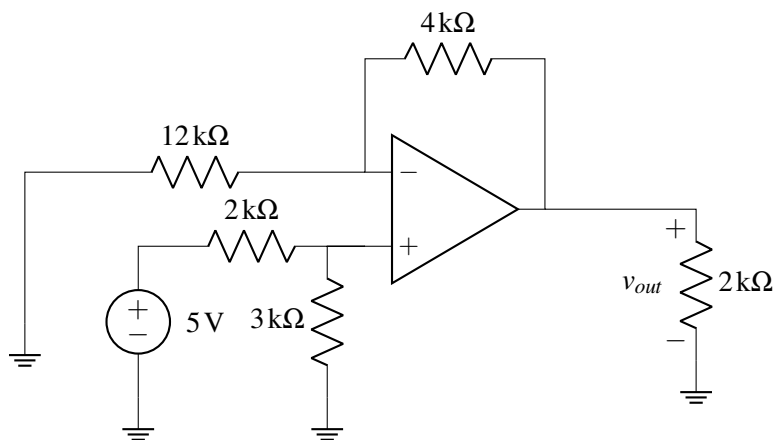# EECS 16A   Designing Information Devices and Systems I
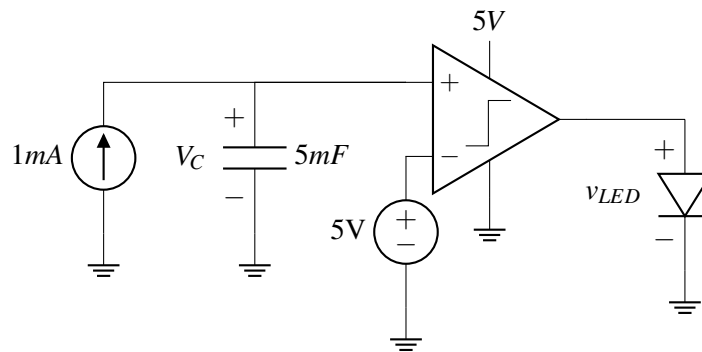## Spring 2023   Exam Prep 12A

1. Op-amps and Comparators (Spring 2022 Midterm 2 Question 10)

(a) You are given the following op-amp in negative feedback. Find v_{out}.

(b) You are given the circuit below. The capacitor is initially uncharged. At time $t = 0$, the current source is turned on. Find $V_c(t)$.

(c) The LED turns on when the voltage across it is greater than 3.3V. Using the same setup as part (b), at what time t does the LED turn on?

2. Eigen Circuits (Spring 2022 Midterm 2 Question 11)

(a) (7 points) You are given the following op-amp circuit in negative feedback.

i. (5 points) Express u_1 and u_2 in terms of V_1, V_2, R_1 and R_2. Assume the op-amp is ideal.
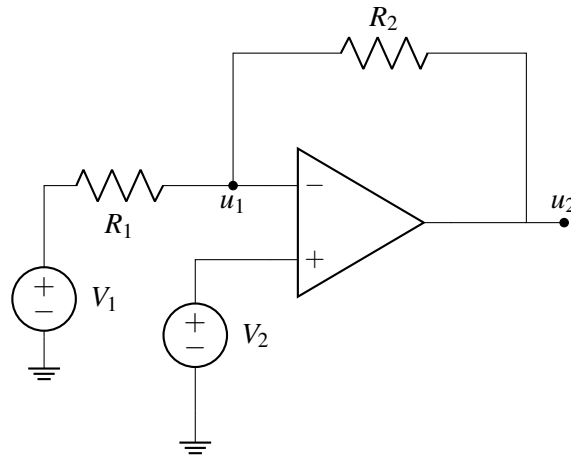
ii. Write the above equations in the form of $A\vec{x} = \vec{b}$. $\vec{x}$ is $\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$ and $\vec{b}$ is $\begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$.

(b) Assume that after plugging in values for R_1 and R_2, the matrix $\mathbf{A}$ you get is $\begin{bmatrix} 0 & 1 \\ -2 & 3 \end{bmatrix}$, find the eigen-value(s) and the eigenvector(s) of this matrix.

(c) Assume you are given another linear circuit with inputs V_1 and V_2 and outputs u_1 and u_2. The eigen-values for this circuit are $\lambda_1 = 1$ and $\lambda_2 = 2$. The corresponding eigenvectors are $\vec{v_1} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, $\vec{v_2} = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$. If we want $u_1 = 3V$, $u_2 = 7V$, what would the input values be?