1. (20%) Consider a rectifier circuit shown in Fig. 1, where the diode is assumed to be ideal.

   (a) (10%) Please plot the waveform of the load voltage $v_L(t)$.

   (b) (10%) Suppose now that the diode D_1 is broken, i.e., always open. Please plot the waveform of the load voltage $v_L(t)$.

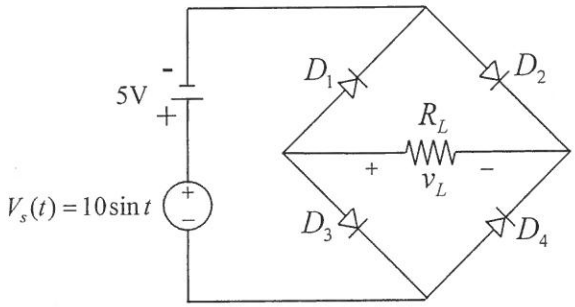

Fig. 1

2. (30%) Consider the circuit shown in Fig. 2.

   (a) (10%) Please reduce the circuit (viewed from the terminals a and b) to a Thevenin equivalent circuit.

   (b) (10%) Please reduce the circuit (viewed from the terminals a and b) to a Norton equivalent circuit.

   (c) (10%) Suppose now we attach a $1\,\Omega$ resistor to the terminals a and b. Please find the current passing through this resistor using (i) Thevenin equivalent circuit and (ii) Norton equivalent circuit.

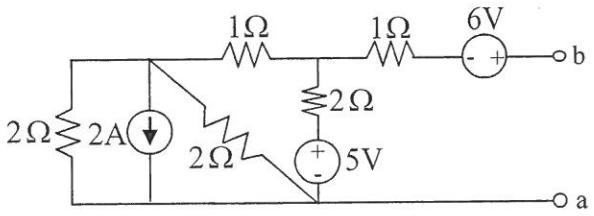

Fig. 2

3. (25%) Fig. 3 shows a RLC circuit wherein $R = 1\Omega$, $L = 1m\text{H}$, and $C = 1m\text{F}$.

(a) (10%) What is the transfer function from the input voltage u to the output voltage y?

(b) (5%) What is the governing equation of the circuit in terms of the input voltage u and the output voltage y?

(c) (5%) Sketch the Bode plot of the transfer function found above in (a).

(b) (5%) Sketch the step response of the transfer function found above in (a). Estimate its steady-state error, rising time, overshoot, and settling time.

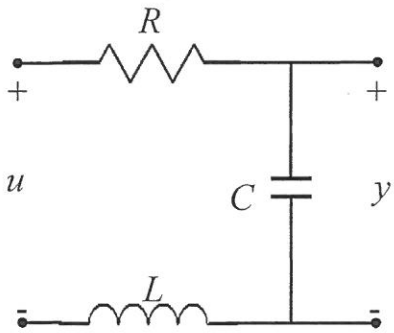

Fig. 3

4. (25%) Fig. 4 shows a schematic circuit comprising Operational Amplifiers, which will function as a feedback compensator. Therein, $C = 1\mu\text{F}$, $R_1 = 100k\Omega$, $R_2 = 10k\Omega$, $R_3 = 1k\Omega$, and $R_4 = 100\Omega$.

(a) (15%) What is the transfer function form the input voltage e to the output voltage u?

(b) (10%) Sketch the Bode plot of the transfer function found above in (a).

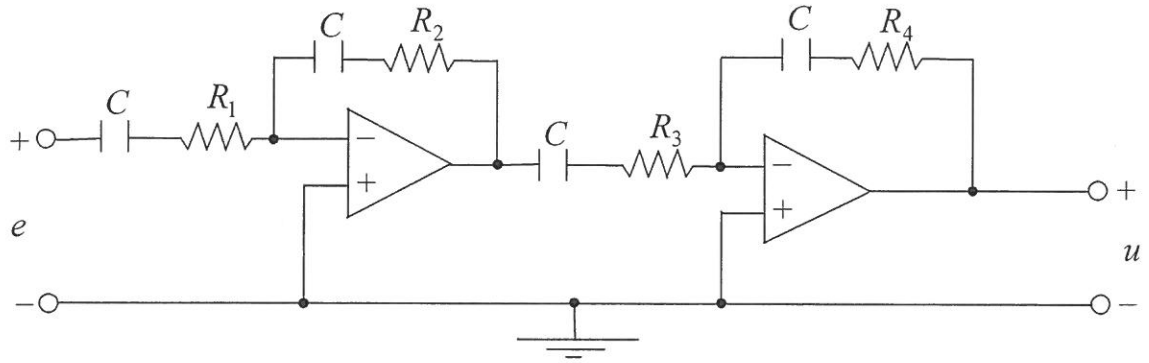

Fig. 4