ME 552 Lab 01 Report

Fan Bu, Feng Zhou, Yi Yang

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Question 1

(a)

We design the circuit as shown below:

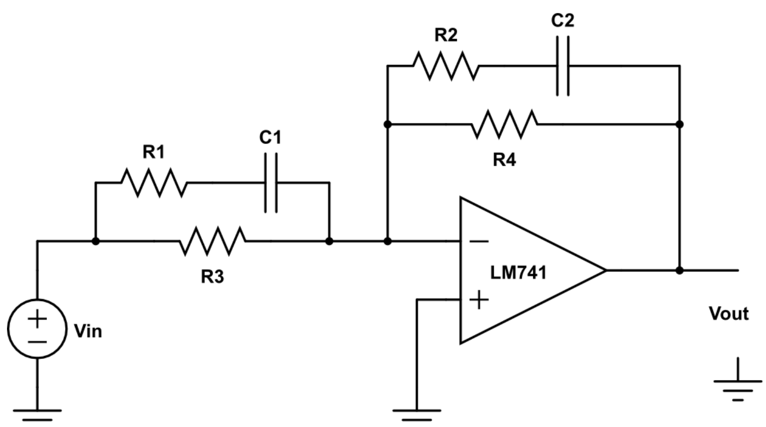

Figure 1: A lead-lag compensator circuit diagram for question 1.

(b)

We can let R_1, C_1, R_3 and R_2, C_2, R_4 form two different impedance module separately, and let their impedance equal Z_1 and Z_2, we can get:

$$Z_1 = \frac{R_3 * (R_1 + (1/sC_1))}{R_3 + (R_1 + (1/sC_1))} = \frac{R_3(sR_1C_1 + 1)}{s(R_1C_1 + R_3C_1) + 1}$$

$$Z_2 = \frac{R_4 * (R_2 + (1/sC_2))}{R_4 + (R_2 + (1/sC_2))} = \frac{R_4(sR_2C_2 + 1)}{s(R_2C_2 + R_4C_2) + 1}$$

The new circuits can be seen as an inverting amplifier:

$$\frac{V_{out}(s)}{V_{in}(s)} = -\frac{Z_2}{Z_1} = -\frac{R_4(sR_2C_2 + 1)}{(s(R_2C_2 + R_4C_2) + 1)} \frac{(s(R_1C_1 + R_3C_1) + 1)}{R_3(sR_1C_1 + 1)}$$

$$= -\frac{R_4}{R_3} \frac{(sR_2C_2 + 1)}{(s(R_2C_2 + R_4C_2) + 1)} \frac{(s(R_1C_1 + R_3C_1) + 1)}{(sR_1C_1 + 1)}$$

If we assume $R_3 = R_4$, we will gain the standard formula of lead-lag compensator.