EE210: Microelectronics-I

Lecture-19 :CE Amplifier
Lower Cutoff Frequency

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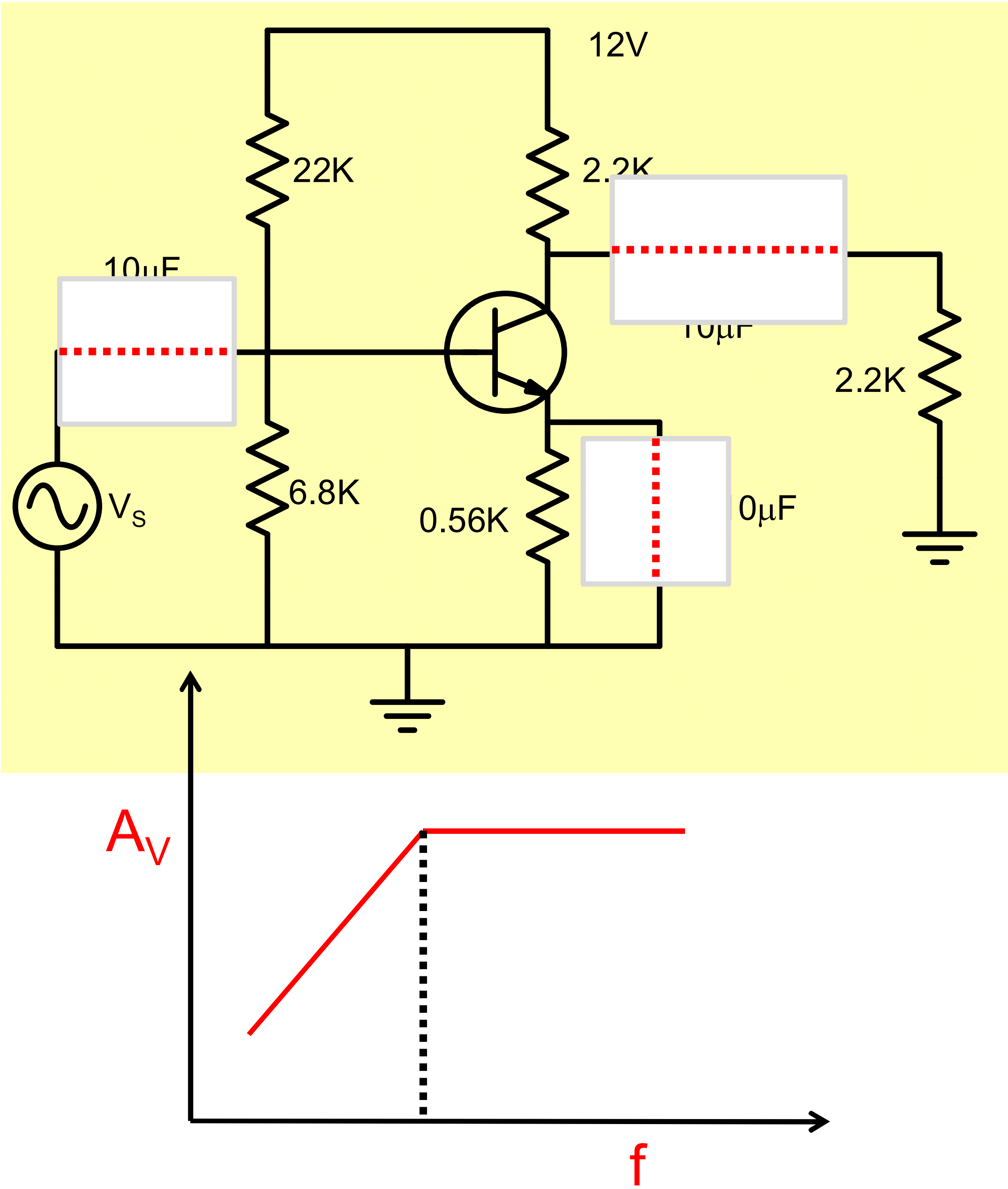
Example



$$I_{CQ} = 3.48mA$$

$$r_\pi = 0.74K\,;\; g_m = 0.13\Omega^{-1}$$
$$A_V = -147.5$$

$$f_B = 24.4Hz$$

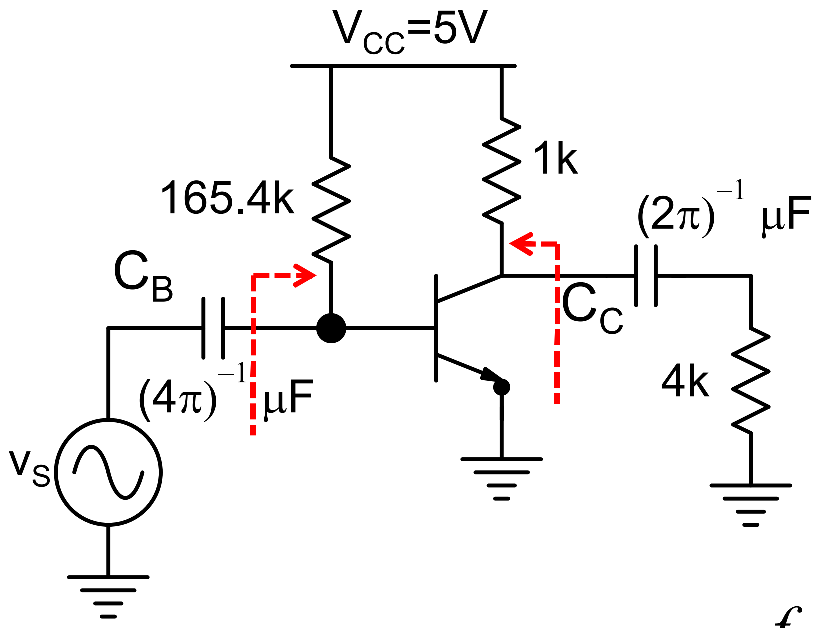
$$f_C = 3.6Hz$$

$$f_E = 2.18KHz$$

$$f_L \cong 2.18KHz$$

Q.1 Determine the lower cutoff frequency for the amplifier shown below. The transistor is biased at 2.6mA.

$$\beta_F = 100; V_T = 26mV$$



$$r_\pi = \frac{V_T}{I_{CQ}}\beta = 1k \qquad f_b = \frac{1}{2\pi C_B R_{in}} = 2kHz$$

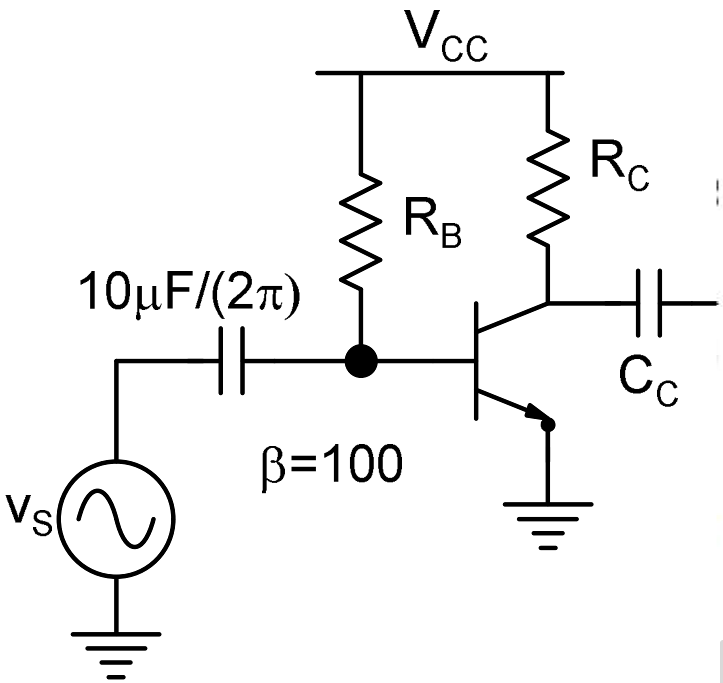
$$R_{in} = R_B \| r_\pi \sim 1k$$

$$f_c = \frac{1}{2\pi C_C \times (R_C + R_L)} = 200Hz$$

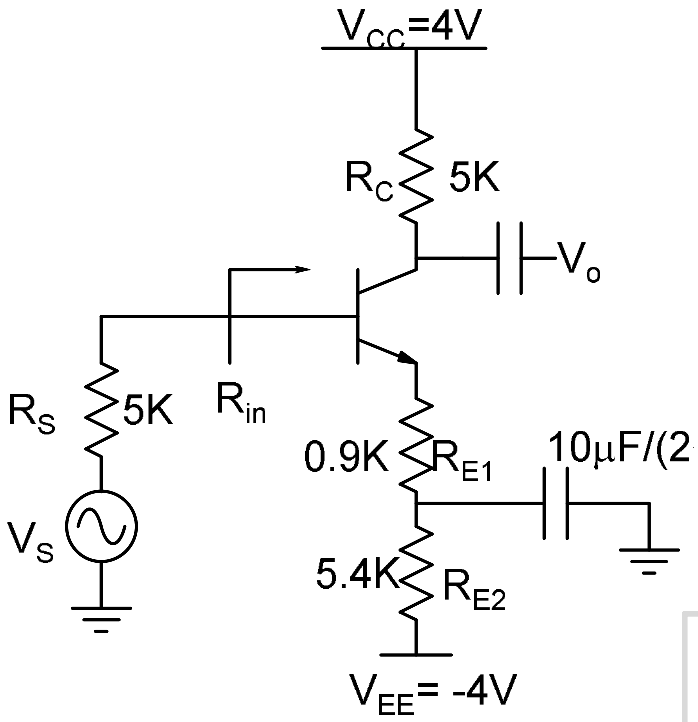
$$f_L \cong f_b = 2kHz$$

In the amplifier shown below, is it possible to obtain the following values for open circuit voltage gain, lower cutoff frequency and output resistance :

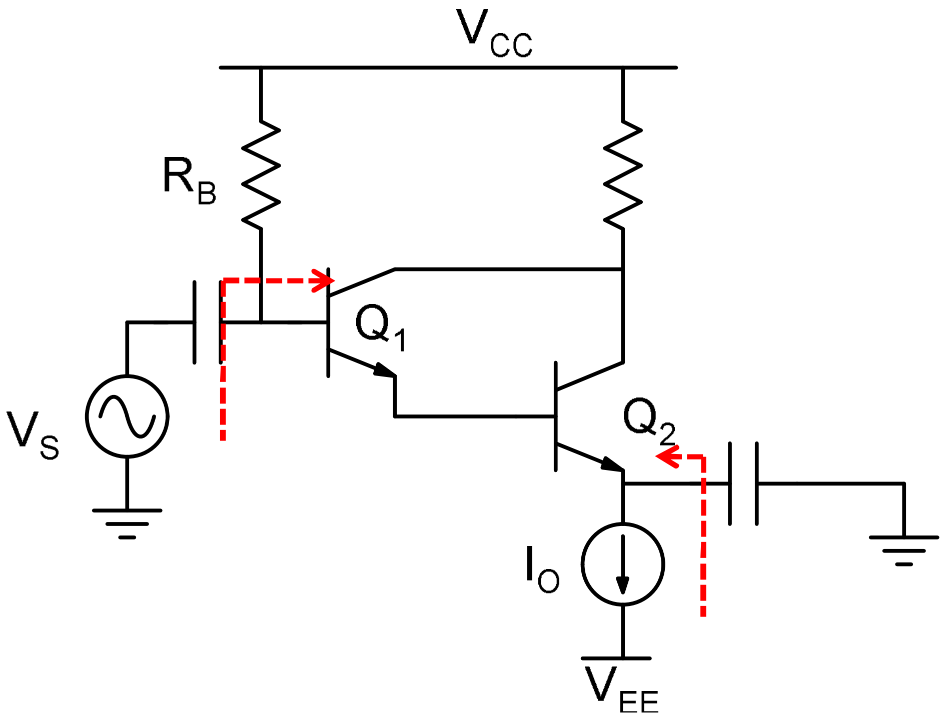
$\left|A_{Vo}\right| \geq 150;\ f_L \leq 100Hz;\ R_o \leq 1k\Omega$ simultaneously? Justify your answer



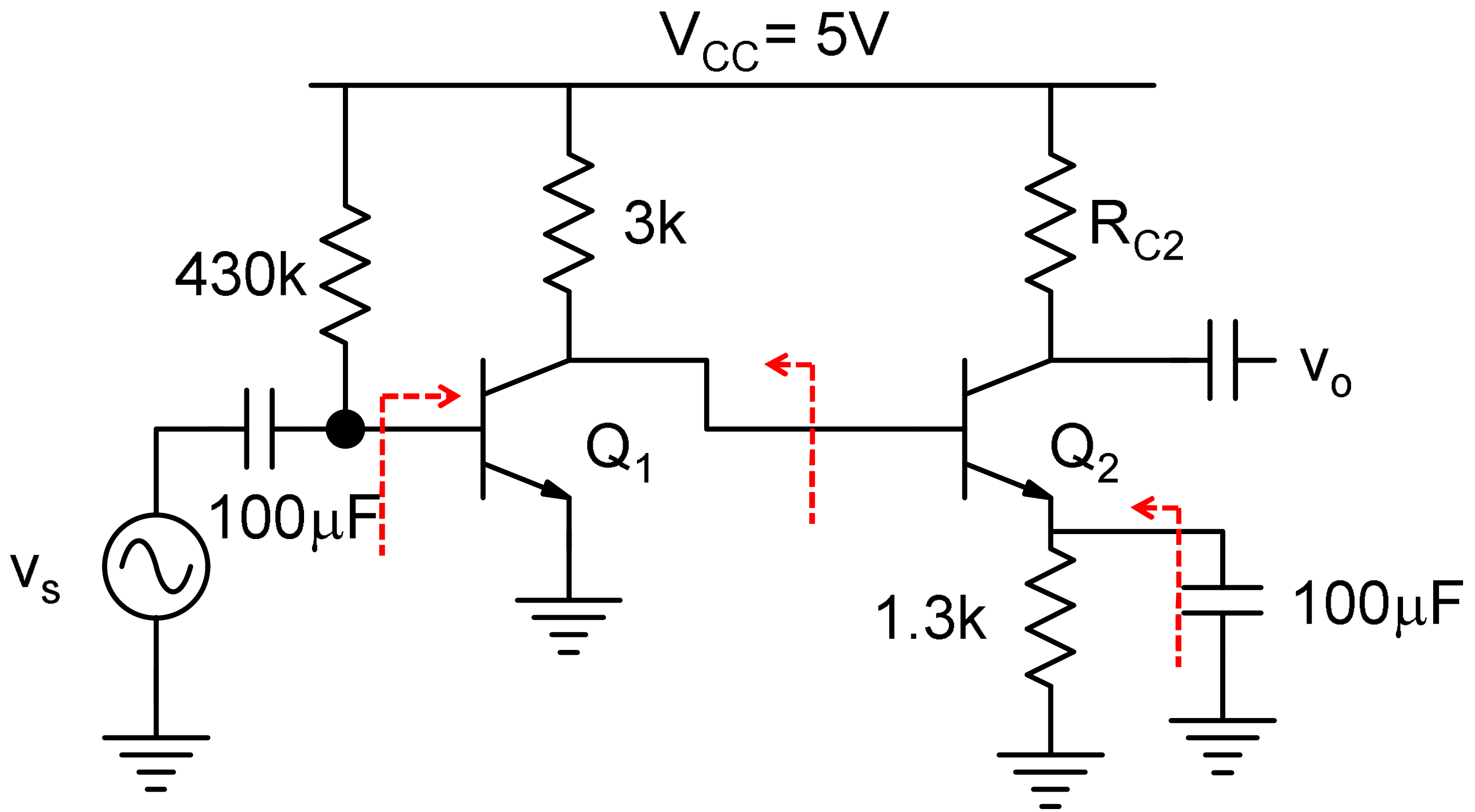
Q.3 Determine lower cutoff frequency of the amplifier shown below



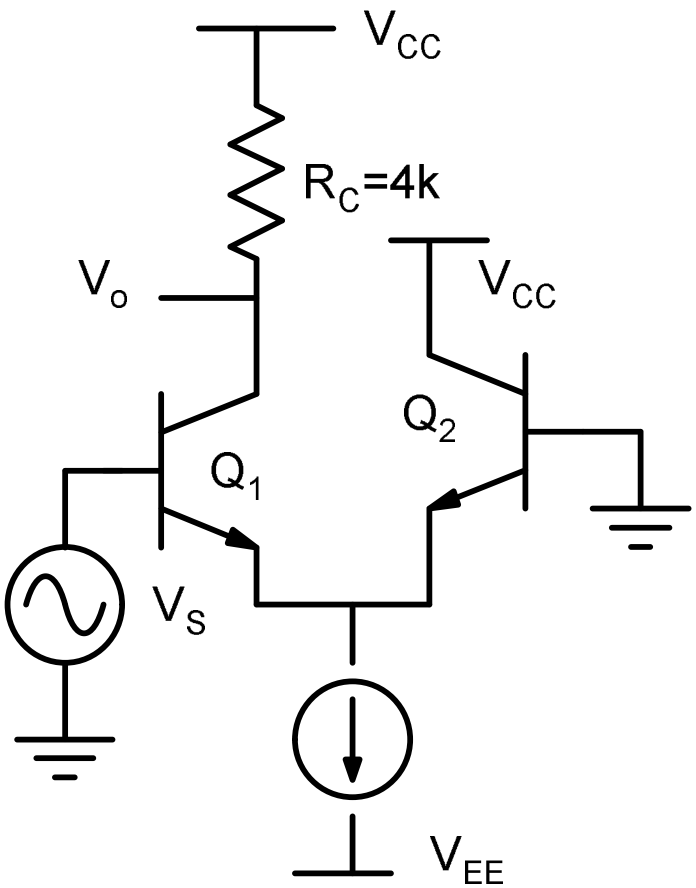
Q.4 Determine lower cutoff frequency of the amplifier shown below

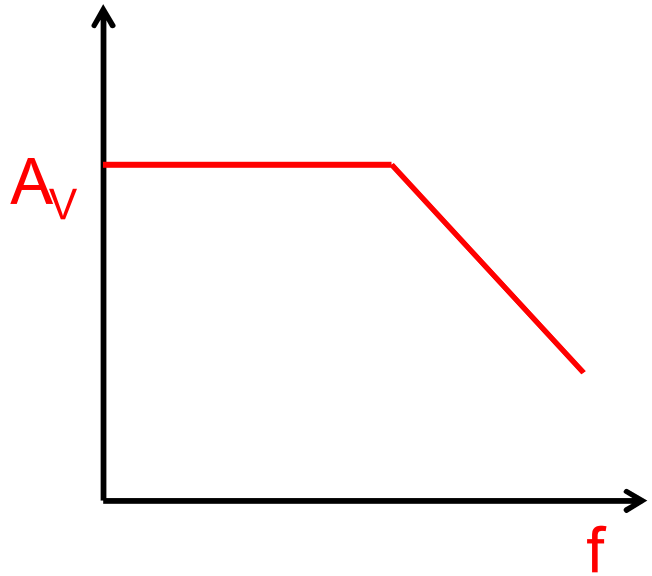


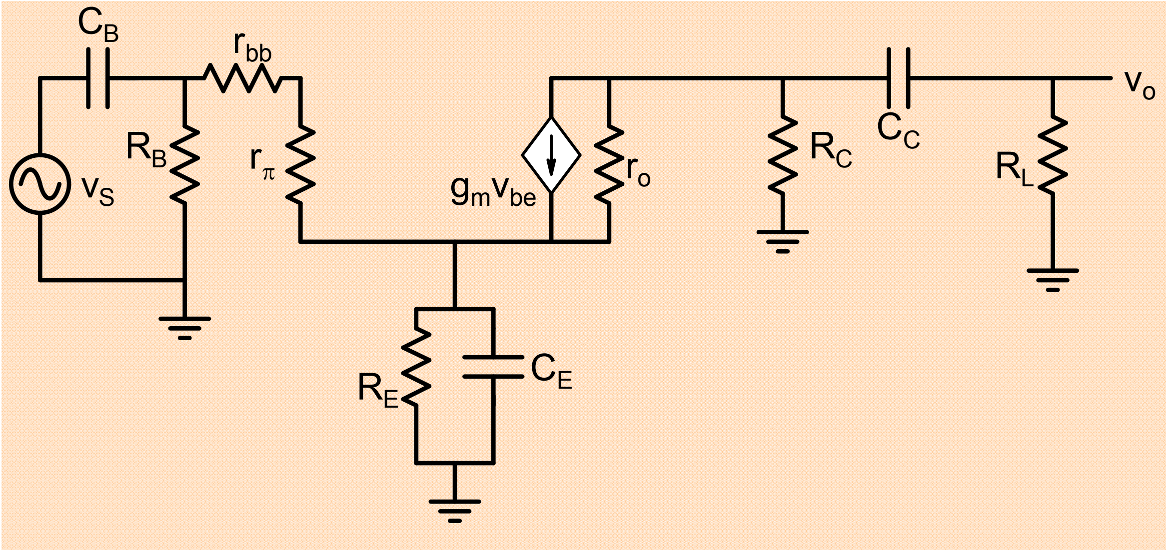
Q.5 Determine lower cutoff frequency of the amplifier shown below



Q.6 Determine lower cutoff frequency of the amplifier shown below







$$H(j\omega) = \frac{v_o}{v_s}$$

(- Hgm_q1 Cc CB RB RC RL) s^2

(- Hgm_q1 Cc CE CB RB RC RE RL) s^3

(+ Gbe_q1 RE + Gbe_q1 RB + Hgm_q1 RE +1)

(+ Gbe_q1 CB RE RS + Gbe_q1 CB RB RS + Gbe_q1 CB RB RE +
Hgm_q1 CB RE RS + Hgm_q1 CB RB RE + CB RS + CB RB + Gbe_q1 CE RB RE +
CE RE + Gbe_q1 Cc RE RL + Gbe_q1 Cc RC RE + Gbe_q1 Cc RB RL +
Gbe_q1 Cc RB RC + Hgm_q1 Cc RE RL + Hgm_q1 Cc RC RE + Cc RL + Cc RC) s

(+ Gbe_q1 CE CB RB RE RS + CE CB RE RS + CE CB RB RE +
Gbe_q1 Cc CB RE RL RS + Gbe_q1 Cc CB RC RE RS +
Gbe_q1 Cc CB RB RL RS + Gbe_q1 Cc CB RB RE RL +
Gbe_q1 Cc CB RB RC RS + Gbe_q1 Cc CB RB RC RE +
Hgm_q1 Cc CB RE RL RS + Hgm_q1 Cc CB RC RE RS +
Hgm_q1 Cc CB RB RE RL + Hgm_q1 Cc CB RB RC RE +
Cc CB RL RS + Cc CB RC RS + Cc CB RB RL + Cc CB RB RC +
Gbe_q1 Cc CE RB RE RL + Gbe_q1 Cc CE RB RC RE + Cc CE RE RL + Cc CE RC RE) s^2

(+ Gbe_q1 Cc CE CB RB RE RL RS + Gbe_q1 Cc CE CB RB RC RE RS +
Cc CE CB RE RL RS + Cc CE CB RC RE RS + Cc CE CB RB RE RL + Cc CE CB RB RC RE) s^3

(- Hgm_q1 Cc CB RC RL) s^2

(- Hgm_q1 Cc CE CB RC RE RL) s^3

(+ Gbe_q1)

(+ Gbe_q1 CB RE + Hgm_q1 CB RE + CB + Gbe_q1 CE RE +
Gbe_q1 Cc RL + Gbe_q1 Cc RC) s

(+ CE CB RE + Gbe_q1 Cc CB RE RL + Gbe_q1 Cc CB RC RE +
Hgm_q1 Cc CB RE RL + Hgm_q1 Cc CB RC RE + Cc CB RL +
Cc CB RC + Gbe_q1 Cc CE RE RL + Gbe_q1 Cc CE RC RE) s^2

(+ Cc CE CB RE RL + Cc CE CB RC RE) s^3

Among important elements of engineering analysis & design are:

- Judicious use of approximations (~)
- Iterative approach
- divide and conquer
- Reuse
- division of labor
- ….