SNS COLLEGE OF TECHNOLOGY

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONENGINEERING

COURSE NAME : 19EC201-ANALOG ELECTRONIC CIRCUITS

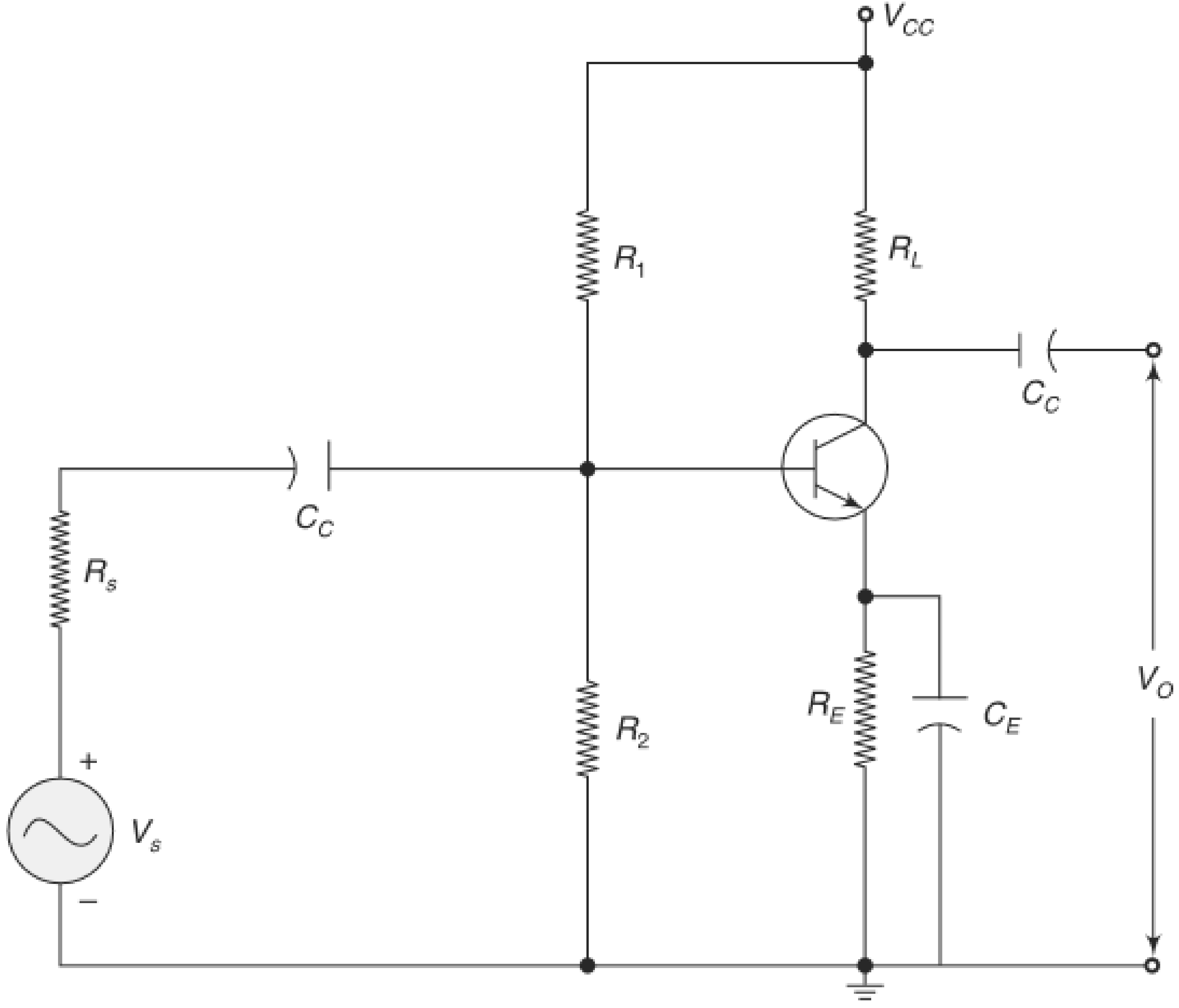
II YEAR /III SEMESTER

Unit 2- BJT AND FET AMPLIFIERS

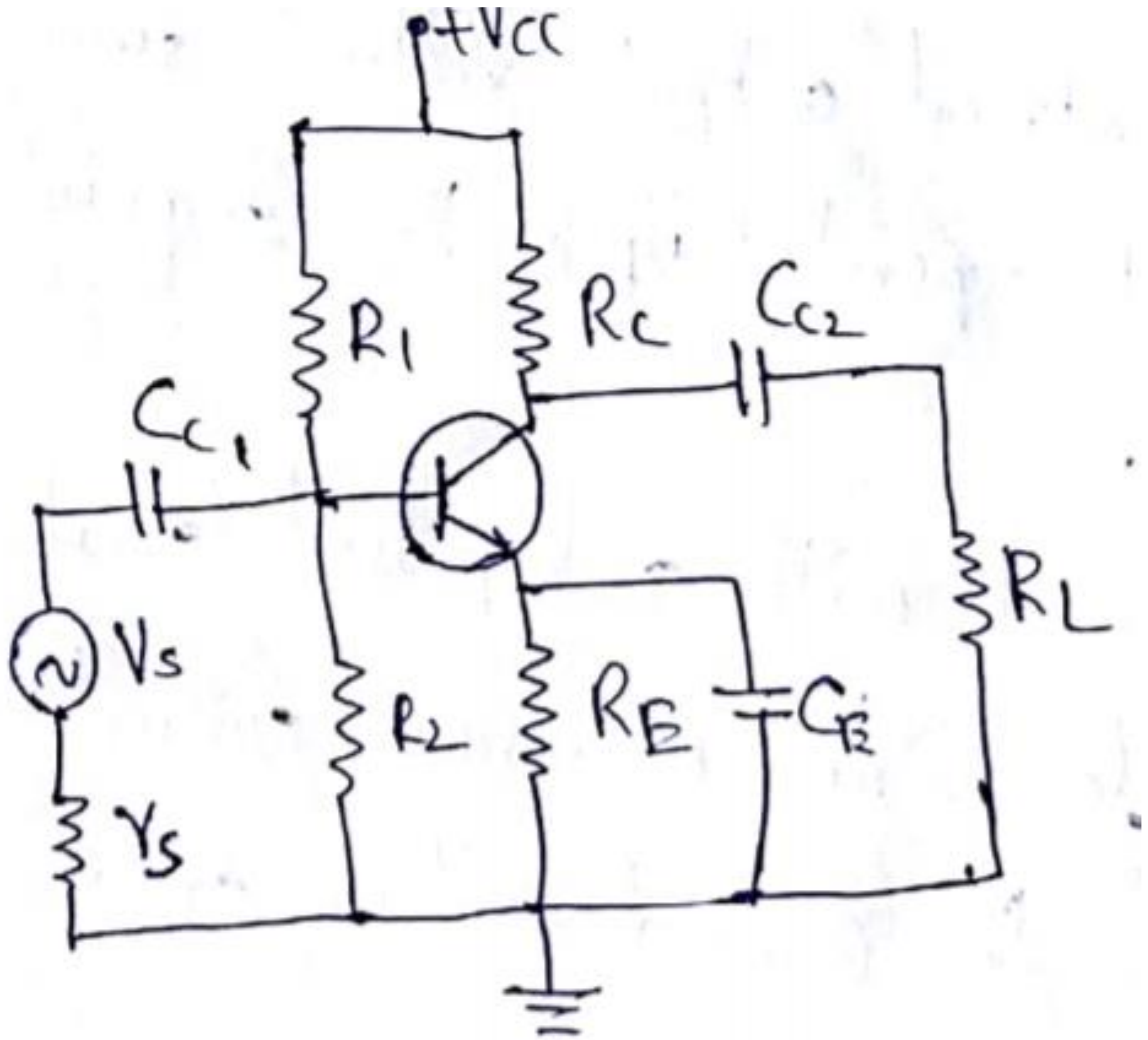
Topic 4 : Low frequency analysis of common emitter amplifier

Low Frequency Analysis of CE Amplifier

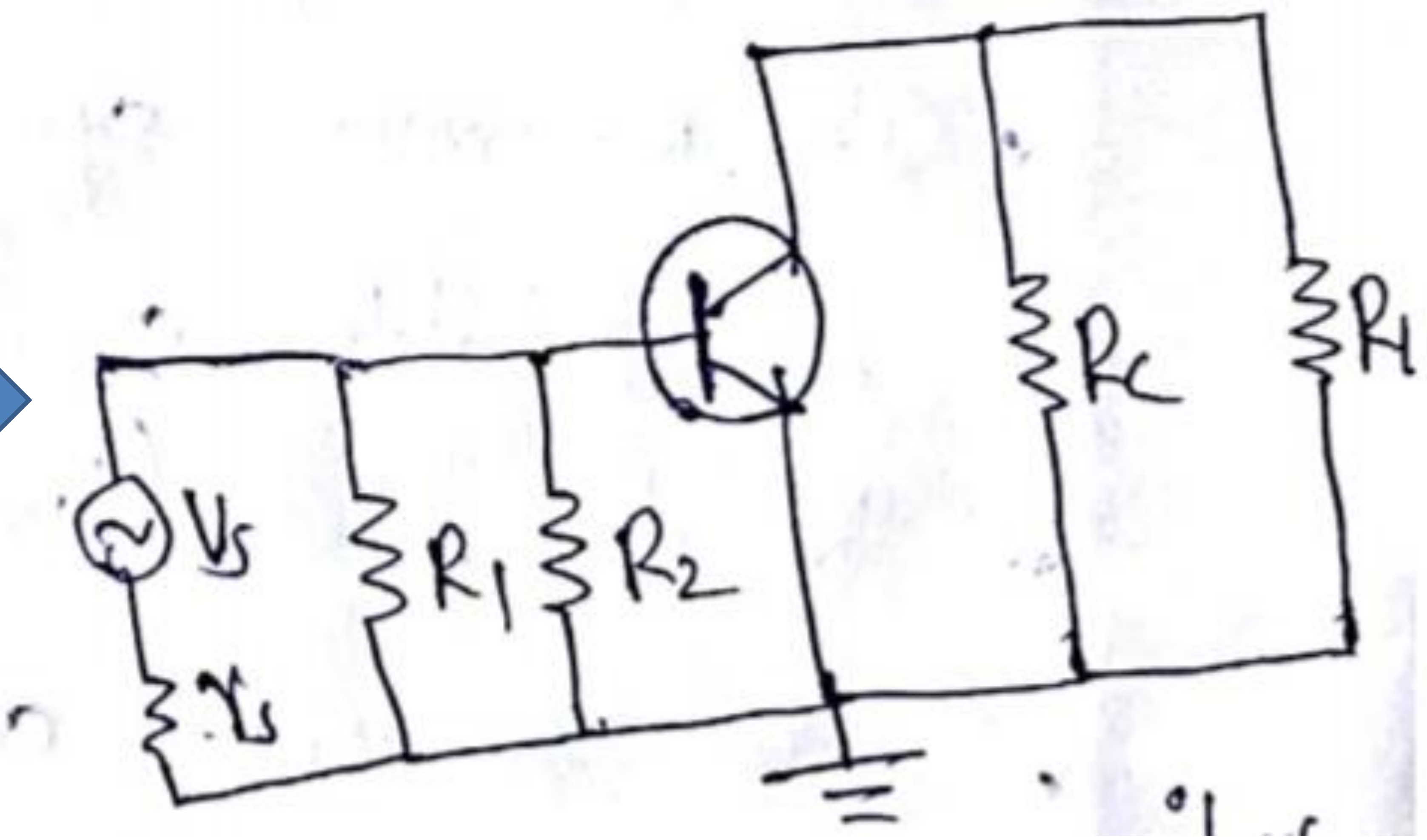
- 180 degree phase shift
- High voltage gain



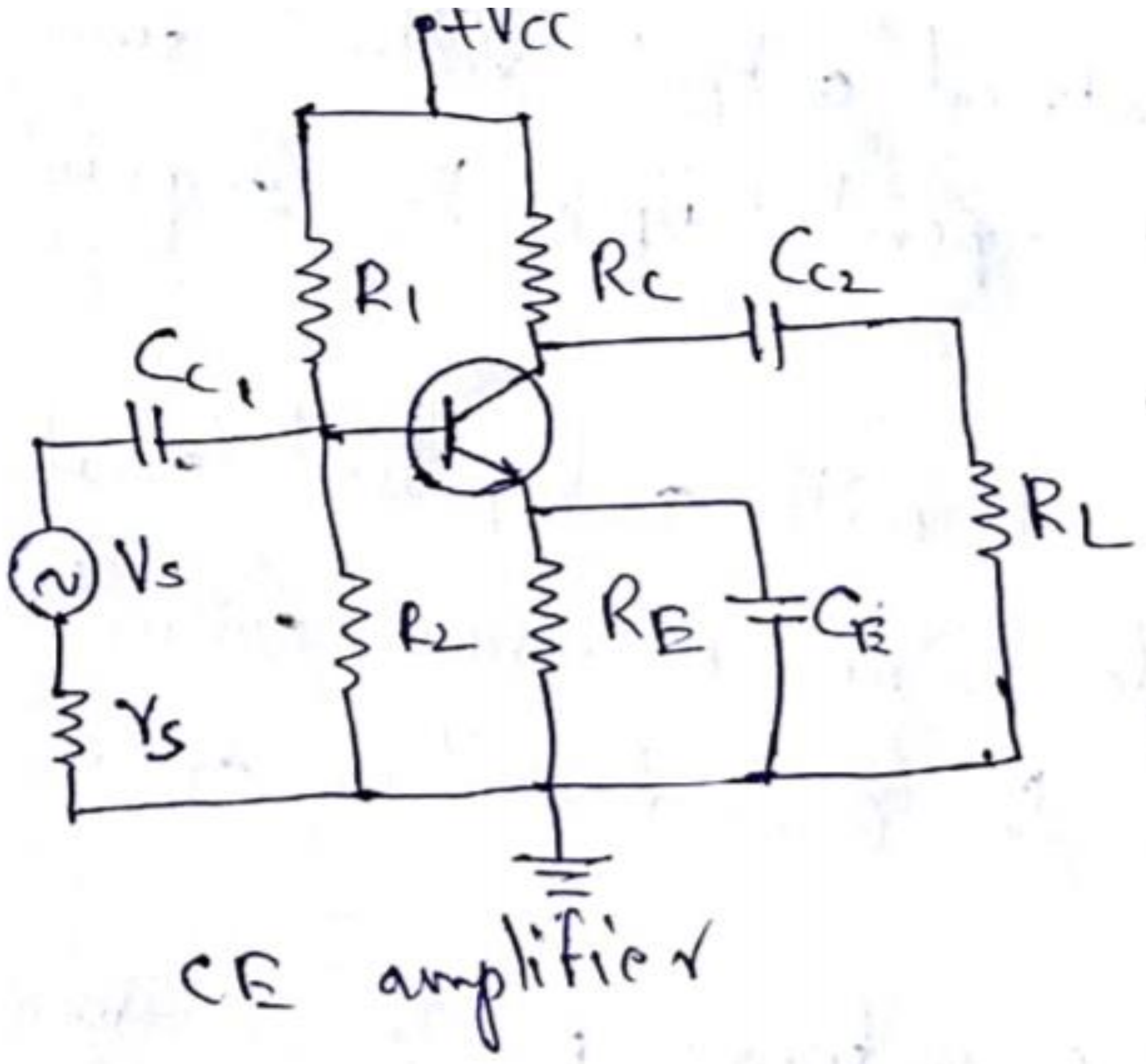
Small signal Analysis of CE Amplifier

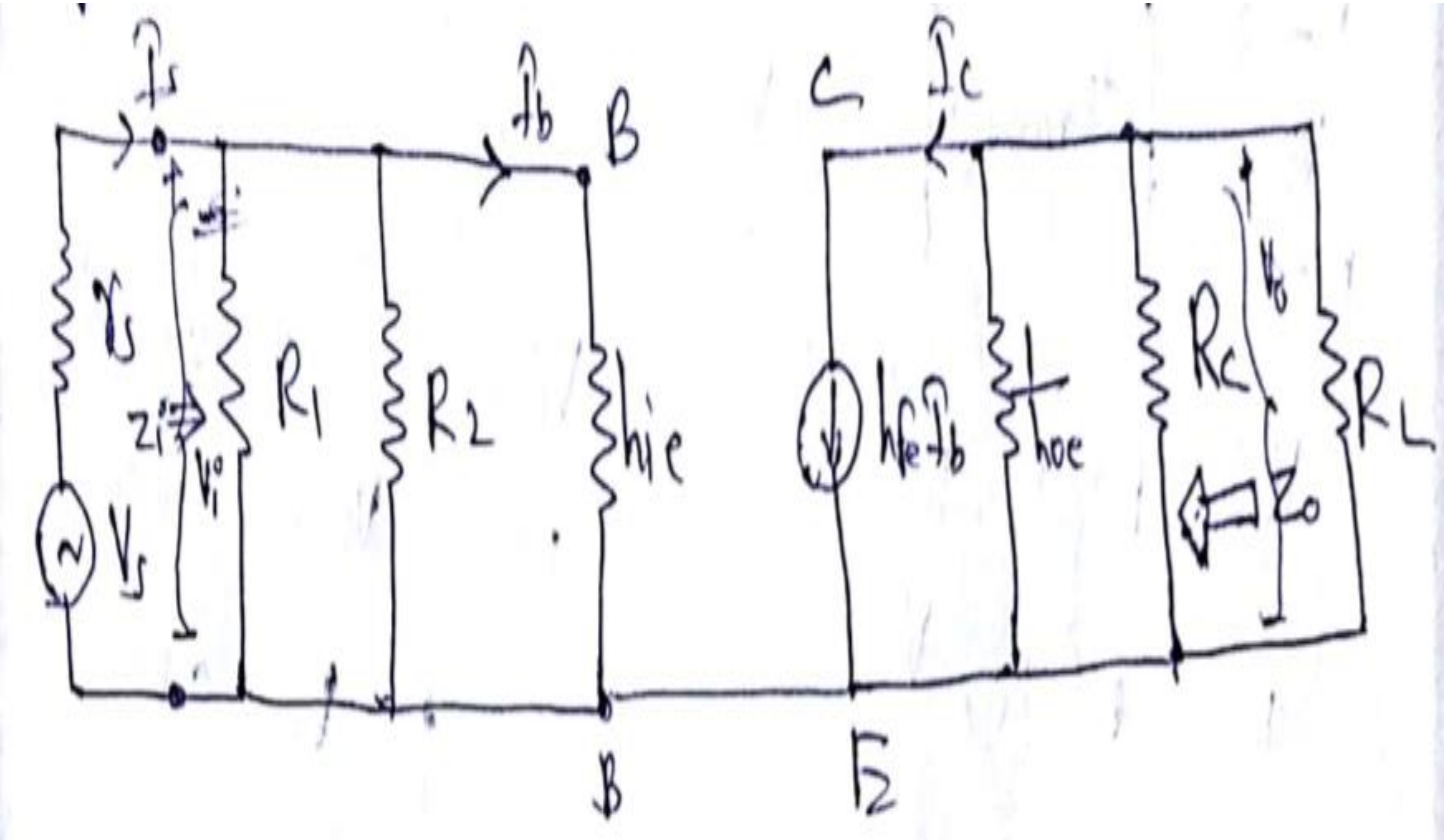


CE amplifier



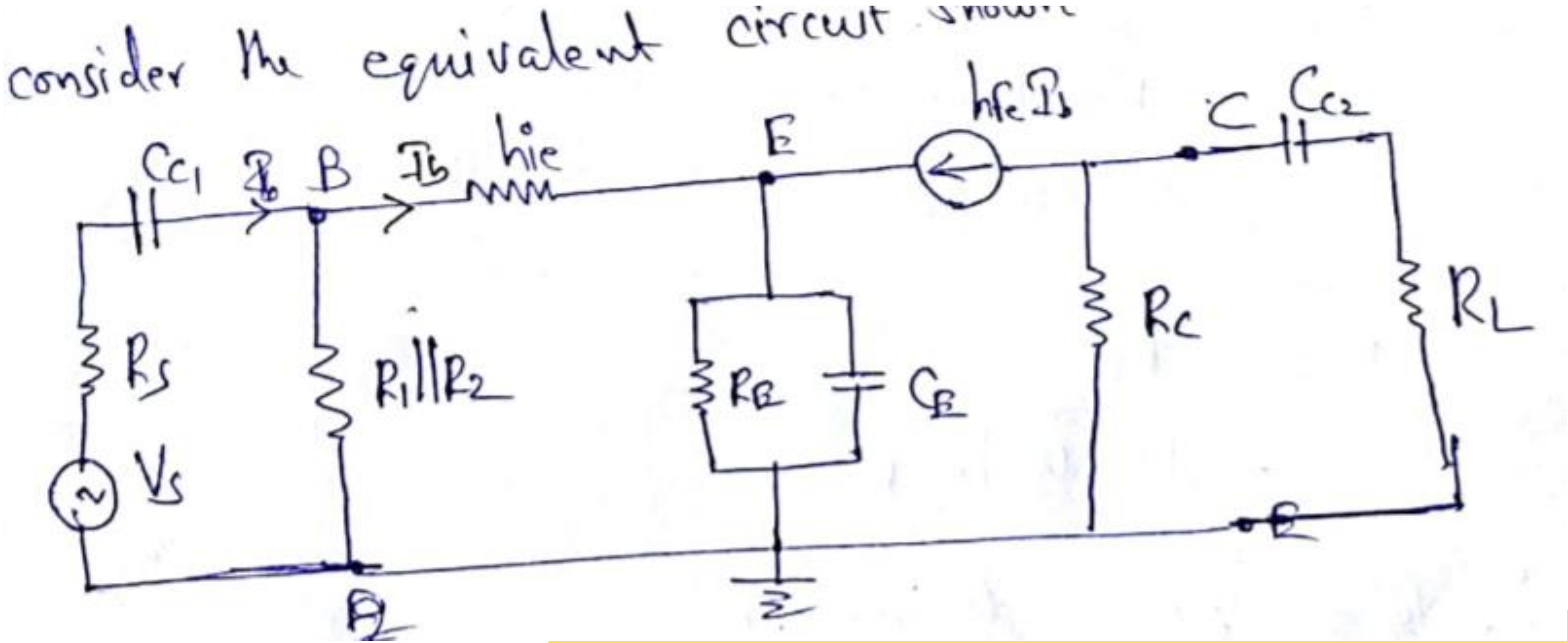
Small signal Analysis of CE Amplifier





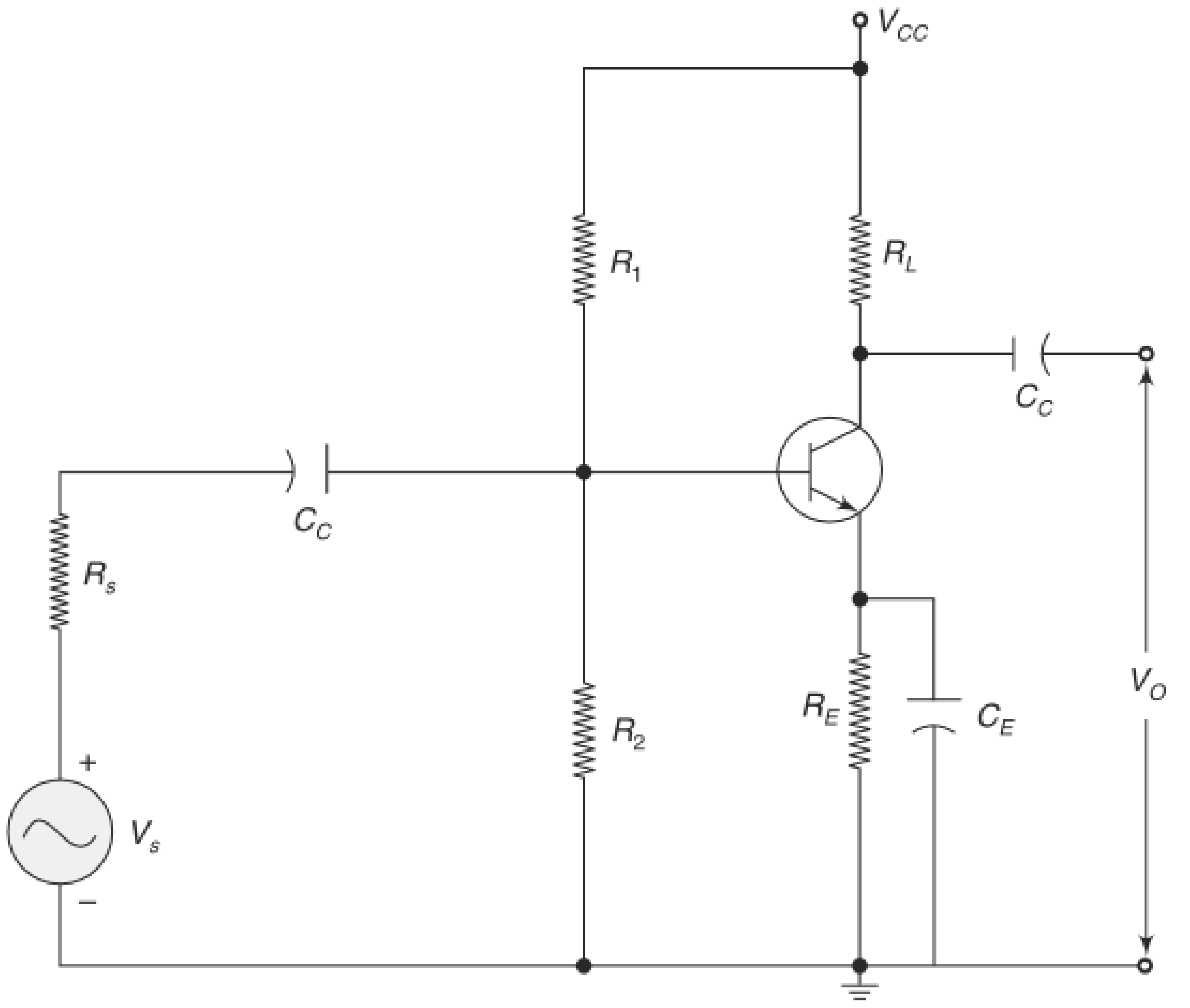
Equivalent Circuit

- At low frequency, the effects of coupling and bypass capacitors are to be considered.



Analysis

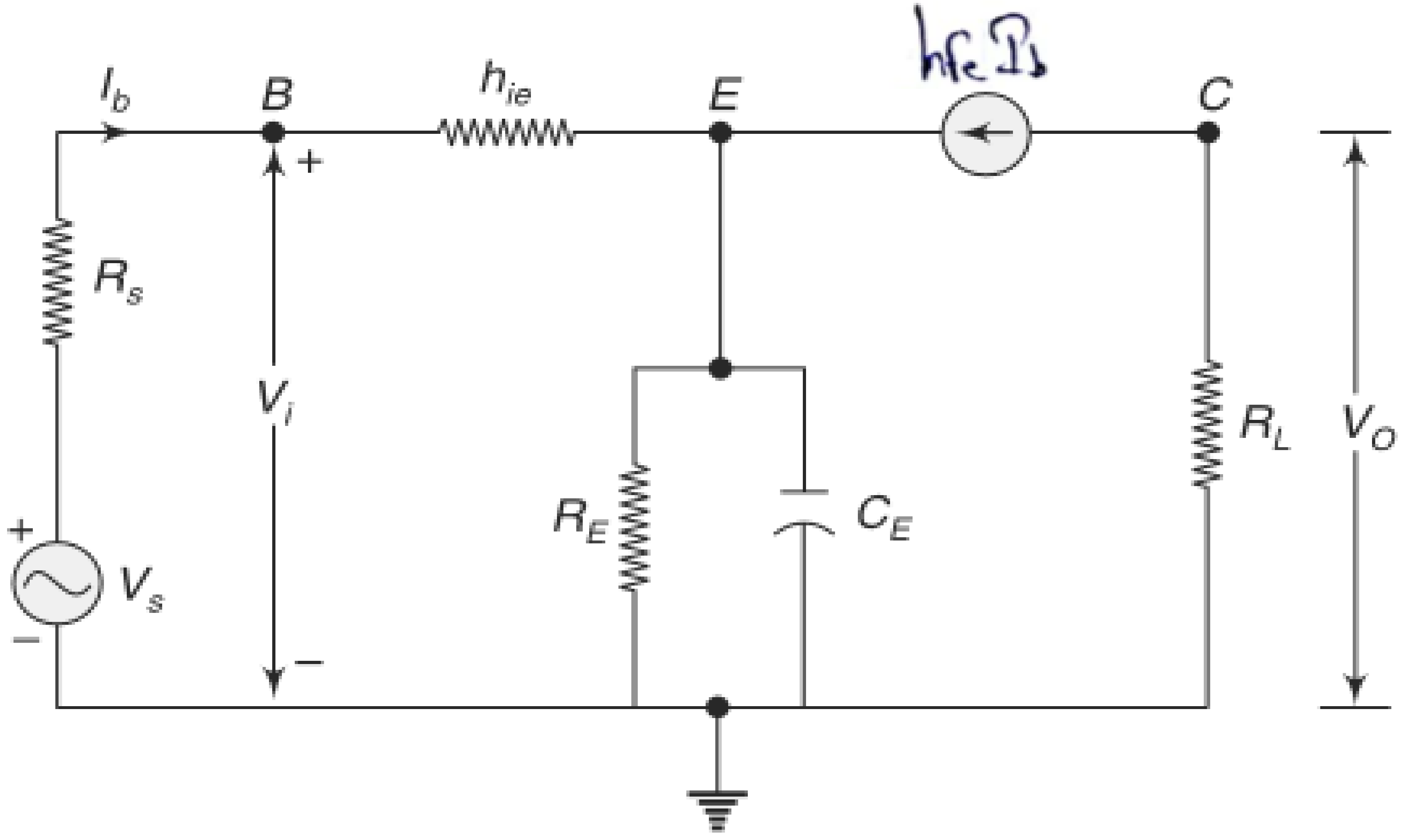
Draw the Input and output waveforms



- Voltage gain at low frequency
- $A_V = V_0 / V_S$

$$V_O = -h_{fe} I_b R_L$$

$$I_b = \frac{V_s}{R_s + R_i}$$

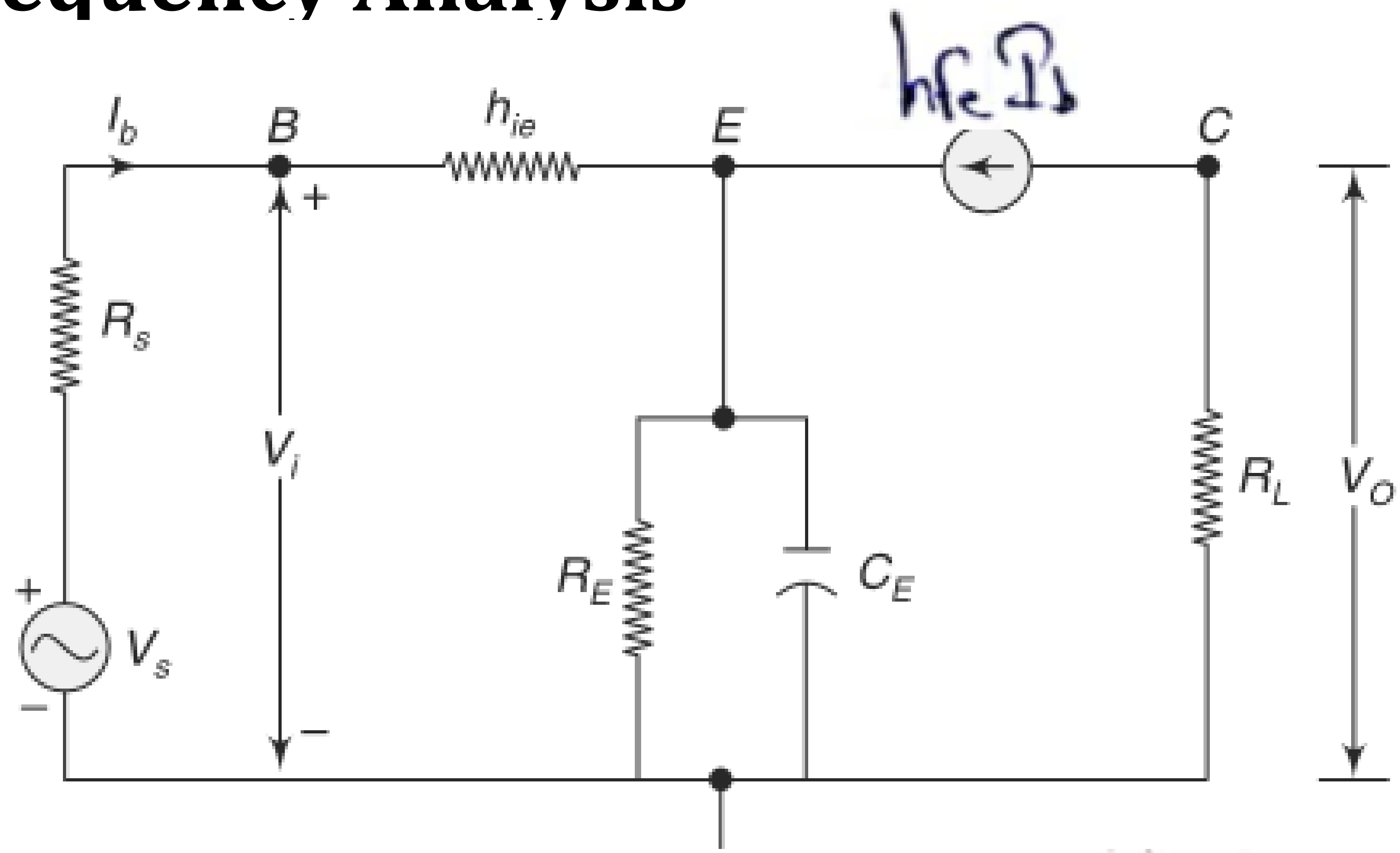


Low Frequency Analysis

$$R_i = h_{ie} + (1 + h_{fe})\, Z_E$$

$$Z_E = R_E \,\|\, X_{CE}$$

$$= \frac{R_E}{1 + j\omega C_E R_E}$$



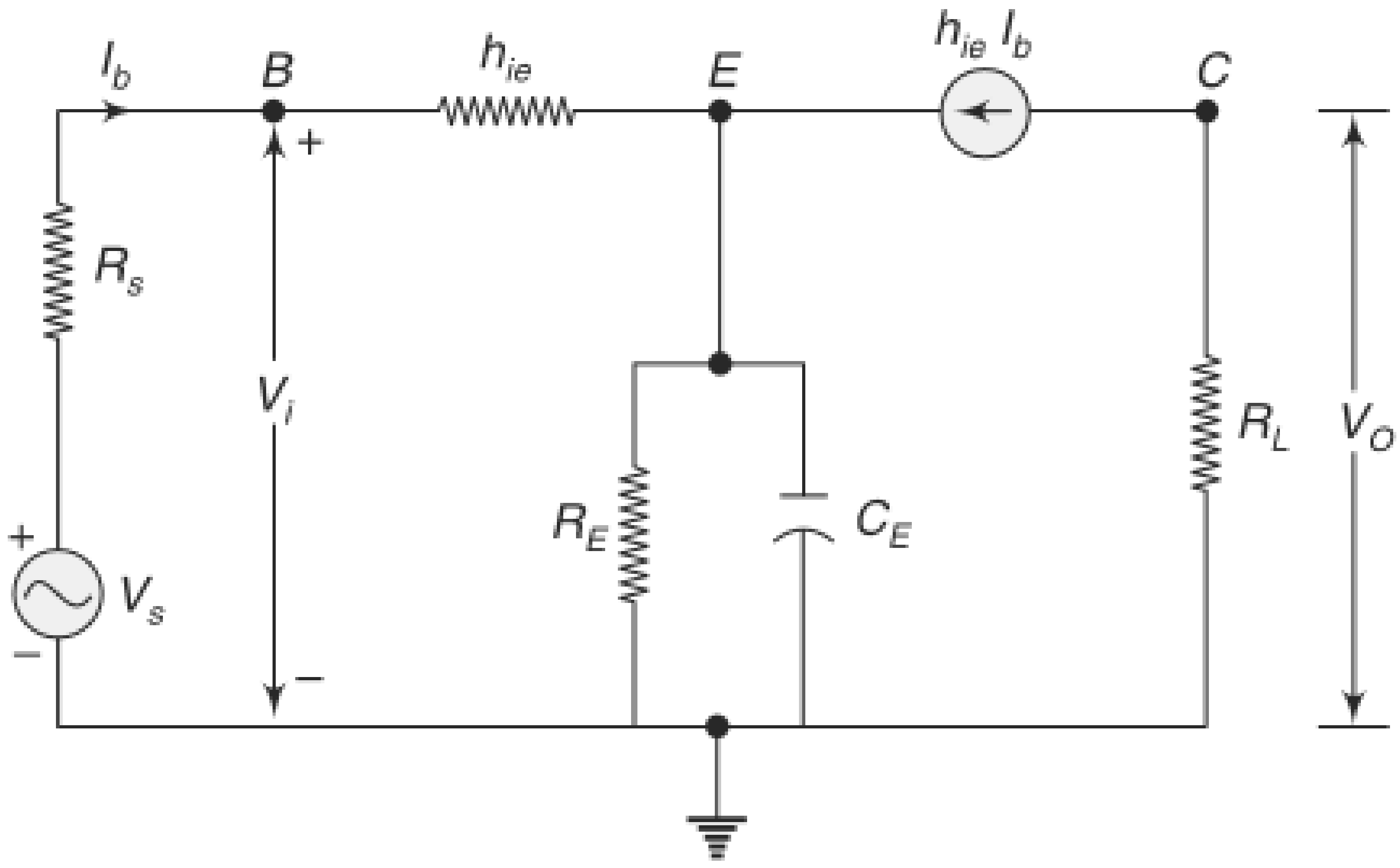
$$Z_E = \frac{R_E X_{CE}}{R_E + X_{CE}} = \frac{R_E \times \frac{1}{j\omega C_E}}{R_E + \frac{1}{j\omega C_E}}$$

$$Z_E = \frac{\frac{R_E}{j\omega C_E}}{\frac{1 + j\omega R_E C_E}{j\omega C_E}}$$

Low Frequency Analysis

$$R_i = h_{ie} + \frac{(1 + h_{fe})\, R_E}{1 + j\omega C_E\, R_E}$$

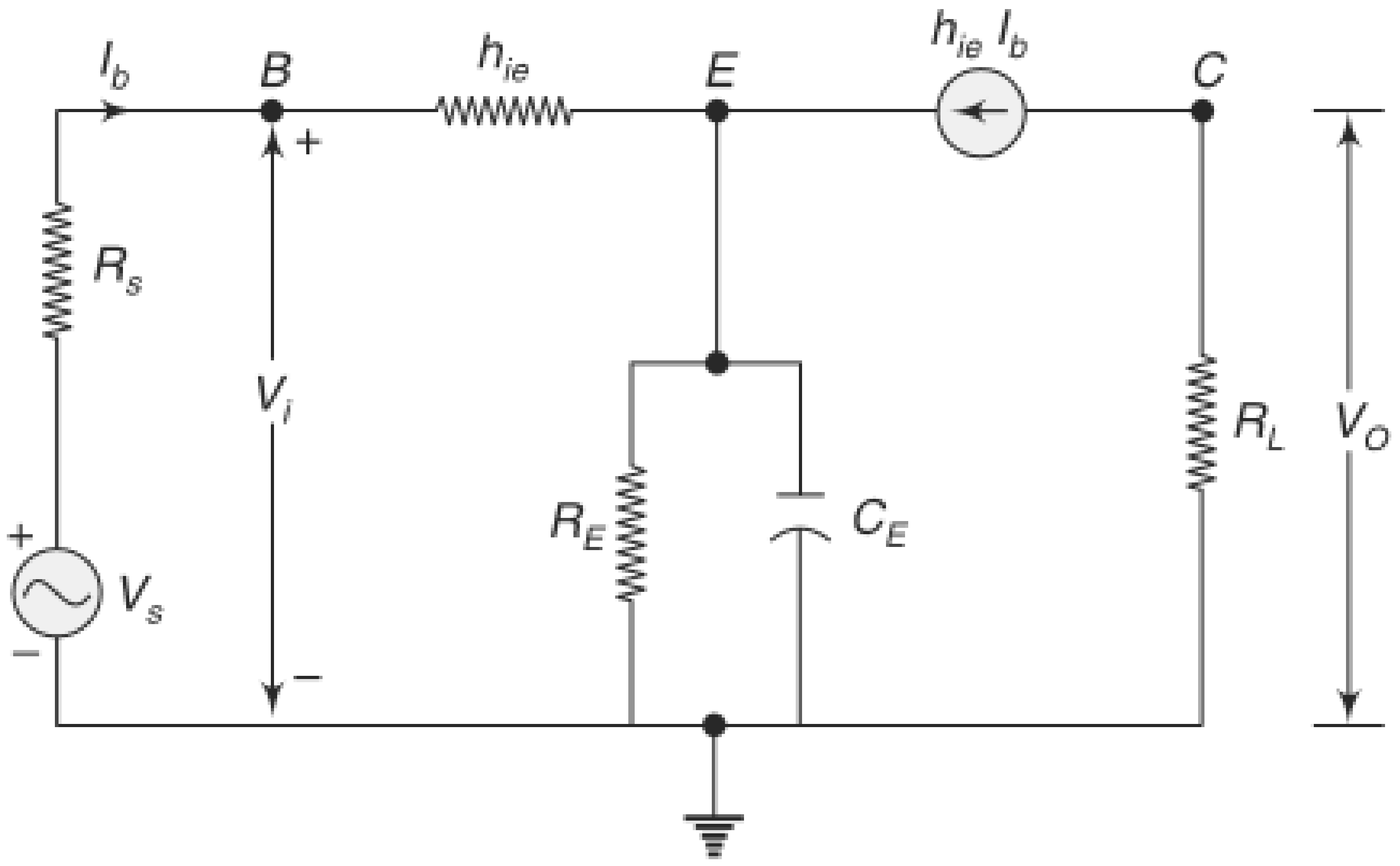
$$I_b = \frac{V_s}{R_s + h_{ie} + \dfrac{(1 + h_{fe})\, R_E}{1 + j\omega C_E\, R_E}}$$



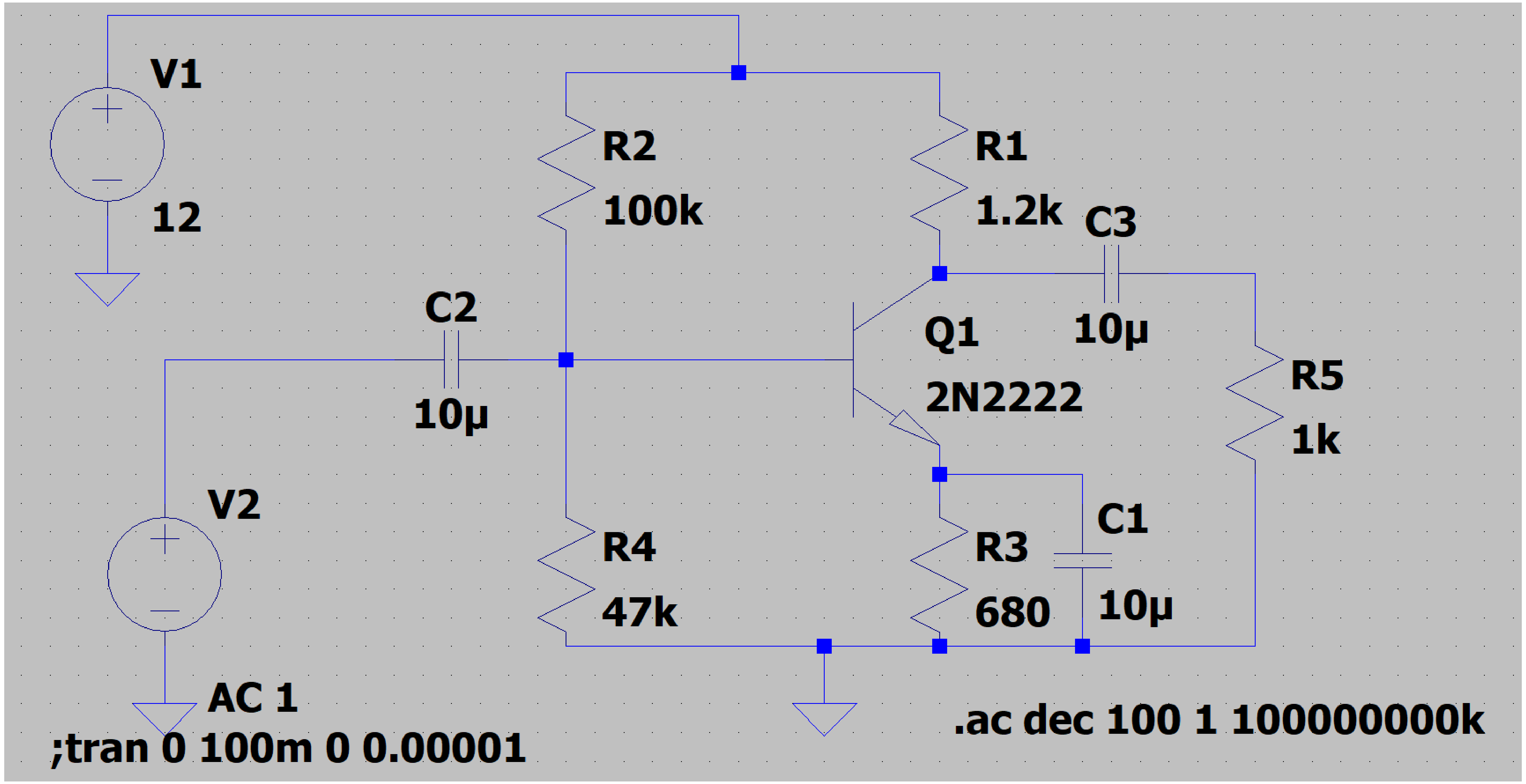
Voltage Gain at Low Frequency

$$V_O = -h_{fe}R_L \frac{V_s}{R_s + h_{ie} + \dfrac{(1+h_{fe})\,R_E}{1 + j\omega C_E R_E}}$$

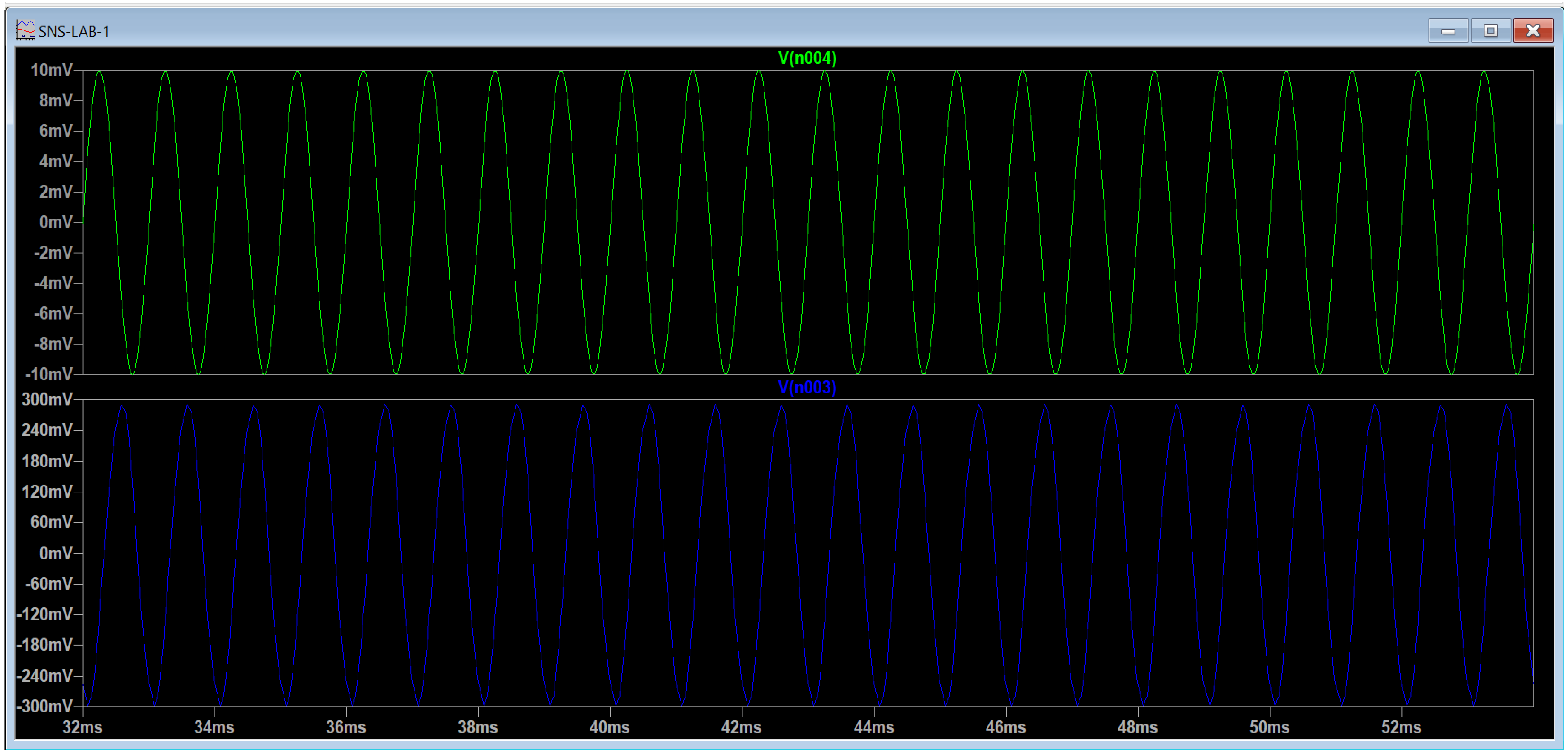
$$A_{V(LF)} = \frac{V_O}{V_s} = \frac{-h_{fe}R_L}{R_s + h_{ie} + \dfrac{(1+h_{fe})\,R_E}{1 + j\omega C_E R_E}}$$



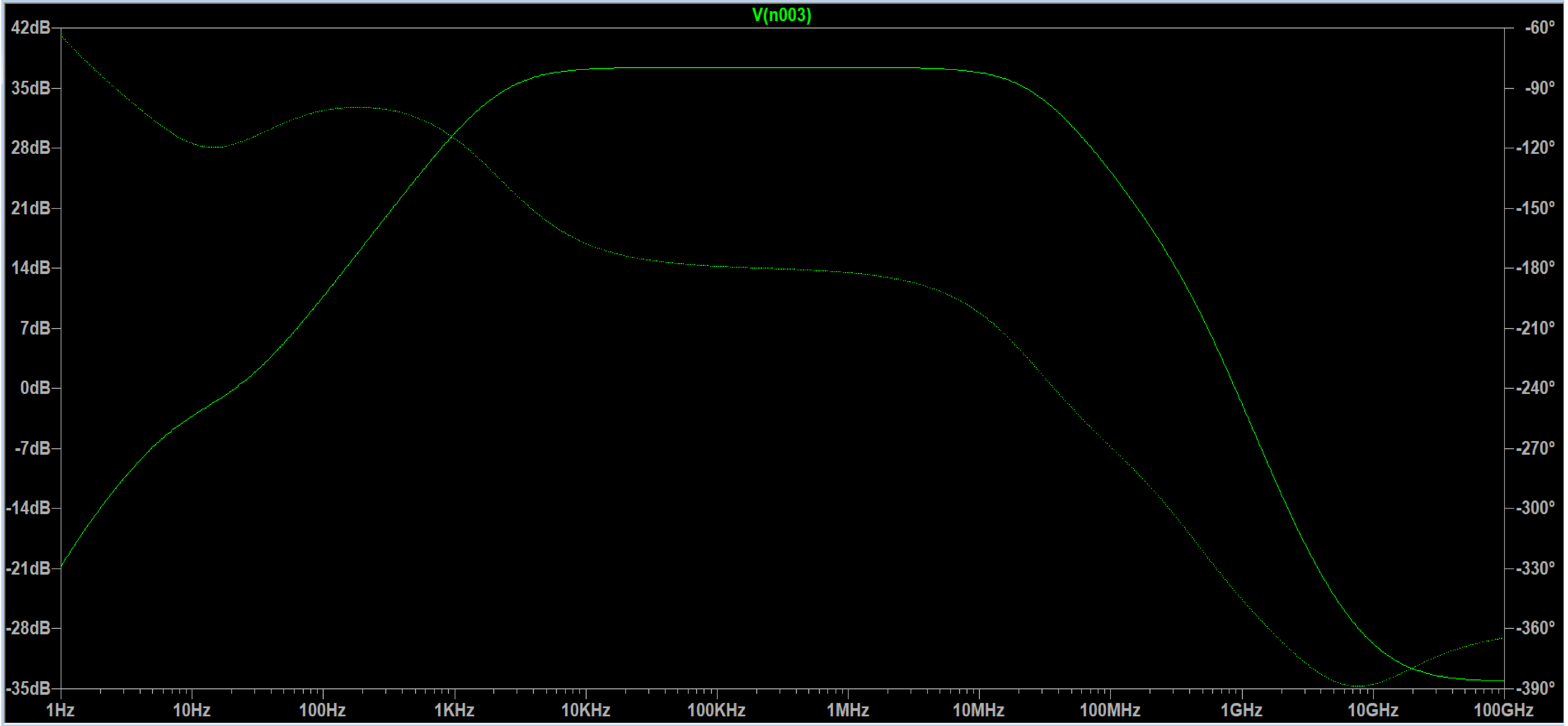
LTSPICE-CE AMPLIFIER



Input and Output Waveforms

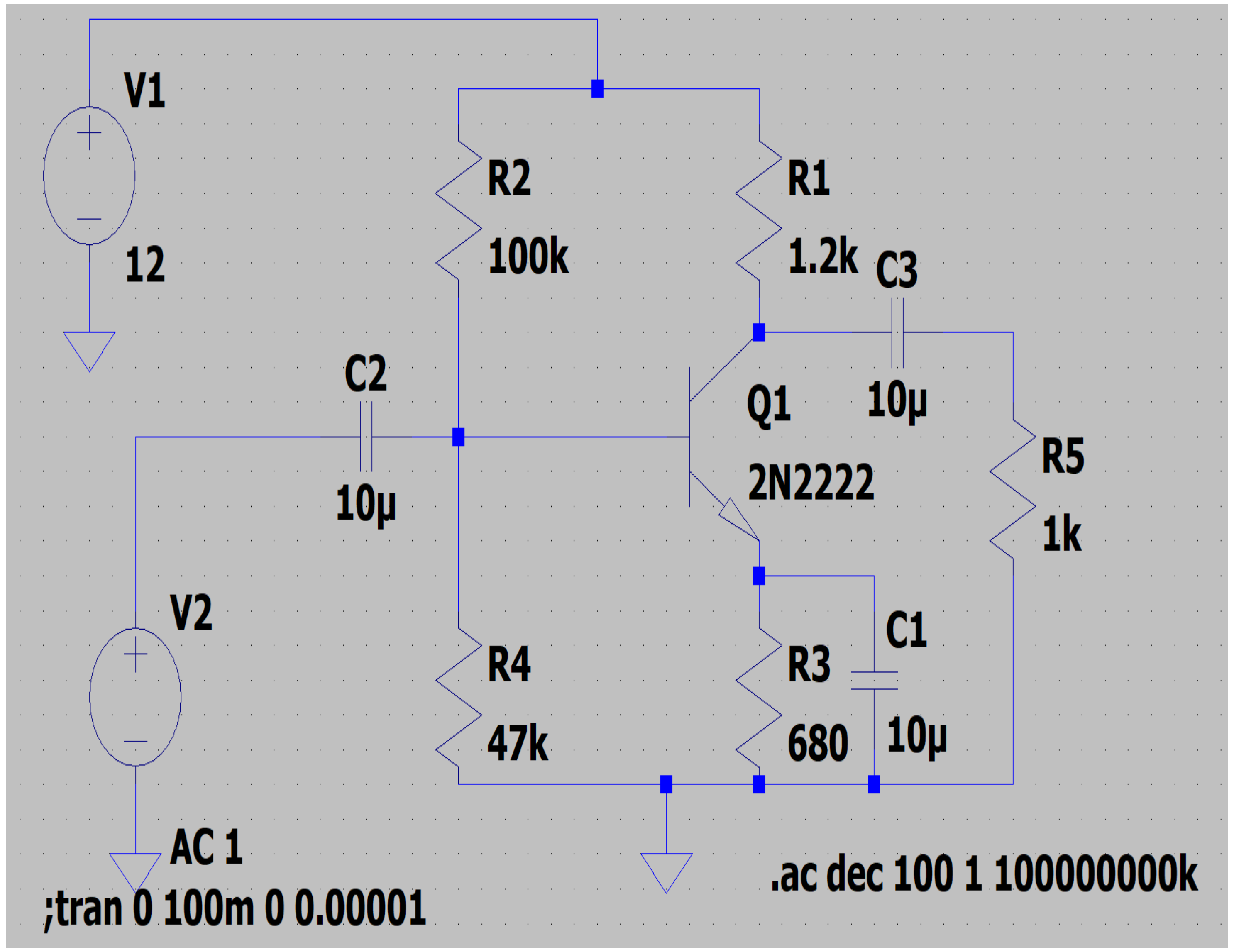


Frequency Response

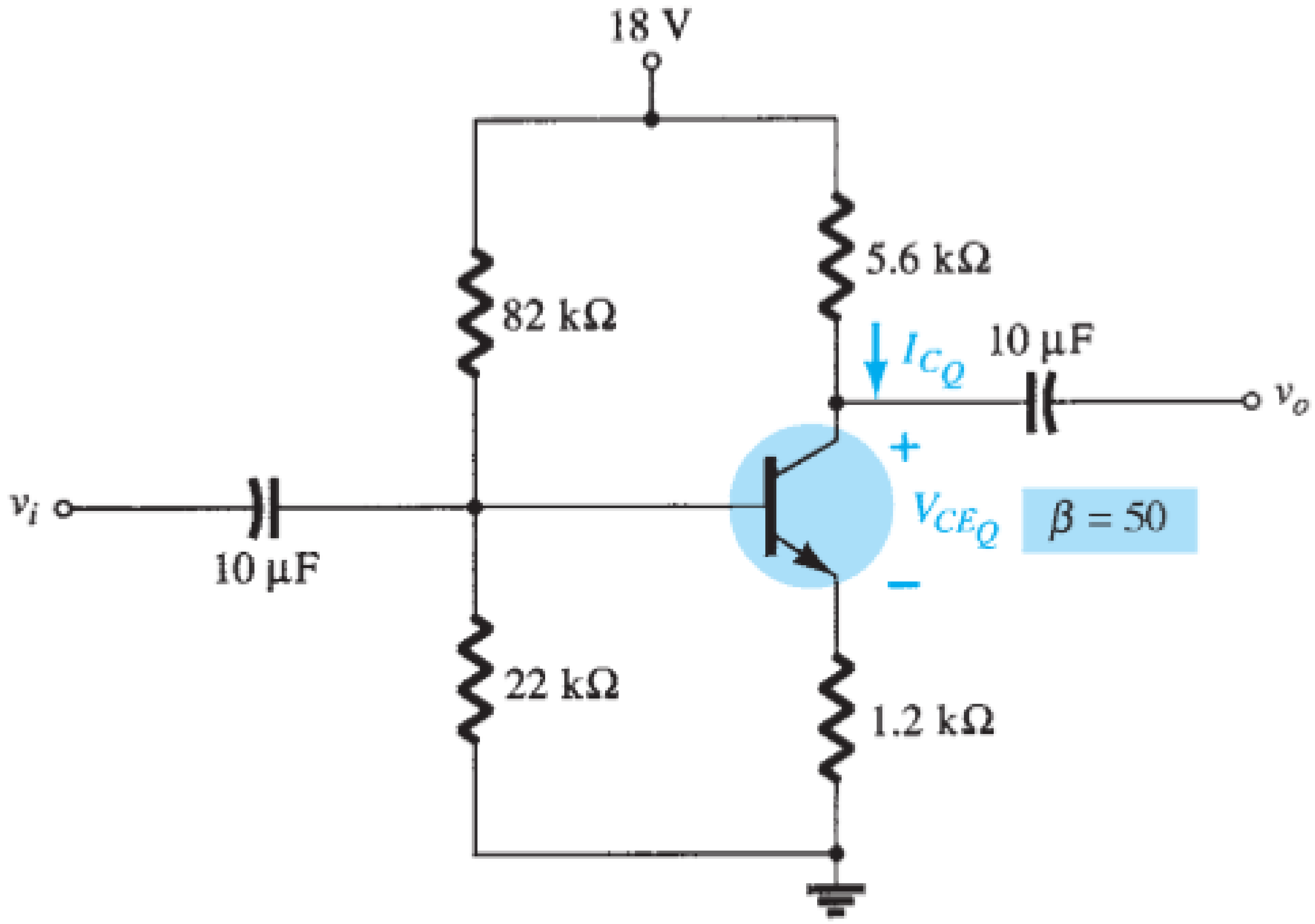


Advantages & Disadvantages

- High Voltage gain
- High bandwidth
- Complex circuit design-Disadvantage



Assessment-1



Assessment 1 (Answer)

$$R_{Th} = R_1 \| R_2 = 82\,k\Omega \| 22\,k\Omega = 17.35\,k\Omega$$

$$E_{Th} = \frac{R_2 V_{CC}}{R_1 + R_2} = \frac{22\,k\Omega(18\,V)}{82\,k\Omega + 22\,k\Omega} = 3.81\,V$$

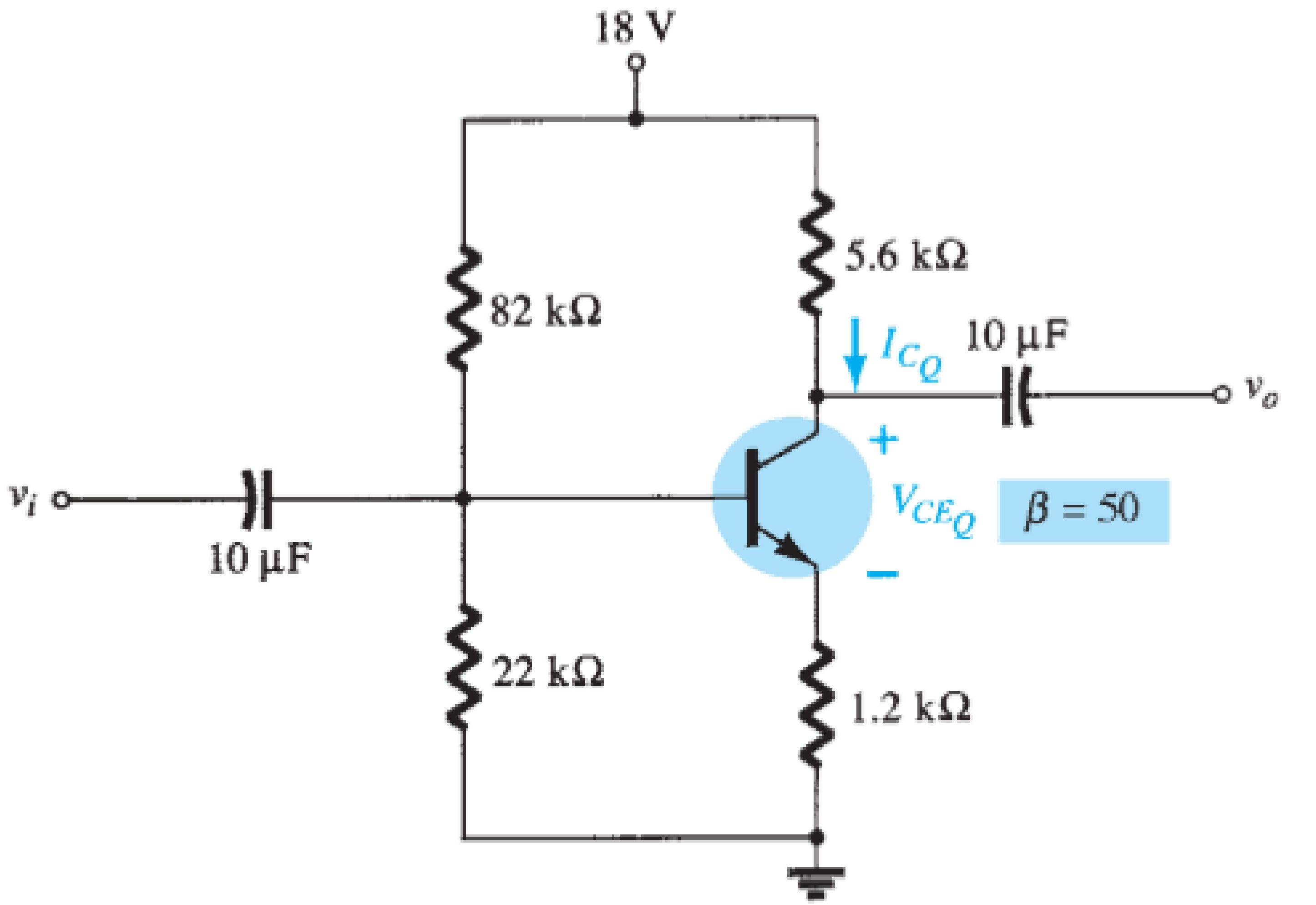
$$I_B = \frac{E_{Th} - V_{BE}}{R_{Th} + (\beta + 1)R_E} = \frac{3.81\,V - 0.7\,V}{17.35\,k\Omega + (51)(1.2\,k\Omega)} = \frac{3.11\,V}{78.55\,k\Omega} = 39.6\,\mu A$$

$$I_{C_Q} = \beta I_B = (50)(39.6\,\mu A) = \mathbf{1.98\,mA}$$

$$V_{CE_Q} = V_{CC} - I_C(R_C + R_E)$$

$$= 18\,V - (1.98\,mA)(5.6\,k\Omega + 1.2\,k\Omega)$$

$$= \mathbf{4.54\,V}$$



References

Electronic Devices and Circuits By Salivahanan

Thank You