Basic Electronics Engineering – IIST

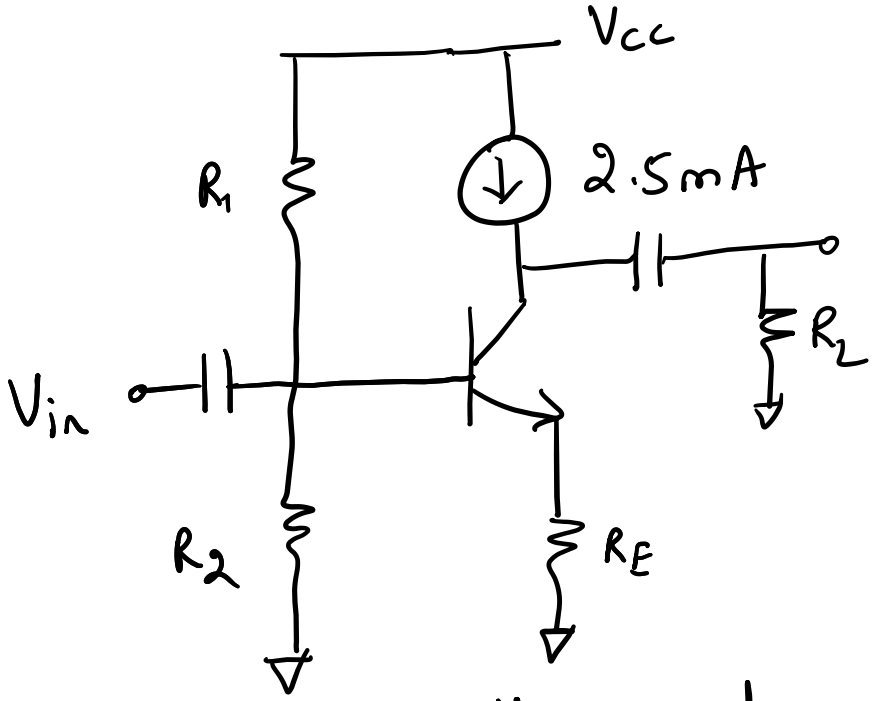
II Semester 2023

Practice Problems

- BJT small signal operation
- Amplifier analysis

Questions:

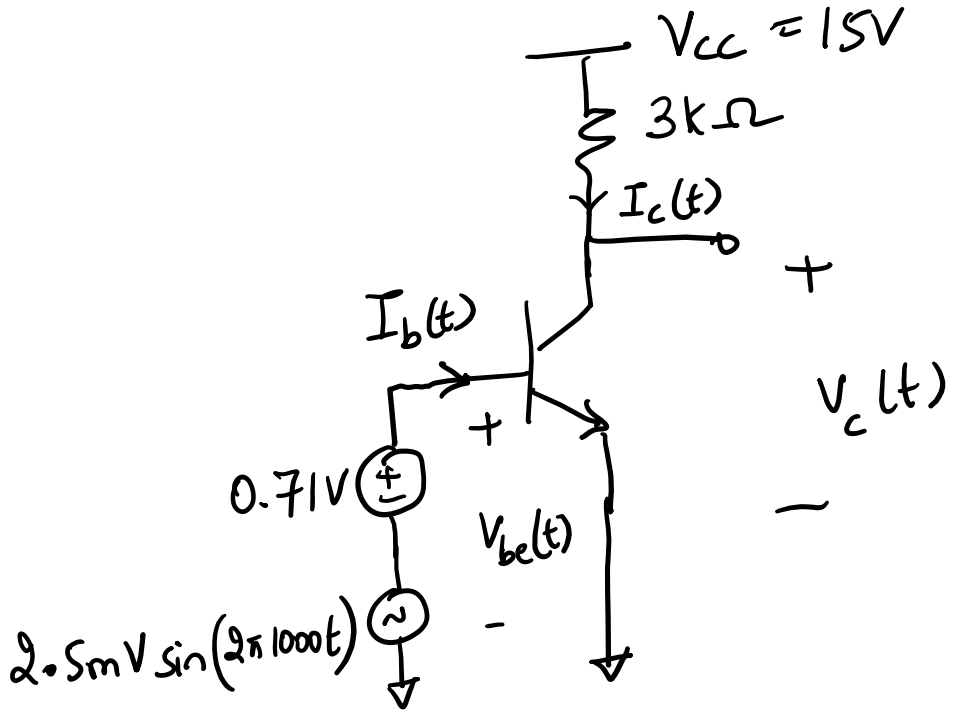
1. Consider the following circuit



Calculate the small signal parameters if $\beta = 200$.
(i) r_π (ii) r_e (iii) g_m (iv) r_o if the Early Voltage = 90V.

Draw the small signal equivalent circuit
Consider all capacitors to be shorts at ac.

2. For the following circuit write the expressions for $V_{be}(t)$, $V_c(t)$, $I_b(t)$, $I_c(t)$



Take $I_s = 5 \times 10^{-15} A$, $n = 1$, $V_T = \frac{kT}{q} = 25mV$

3. A transconductance amplifier has an input impedance of 100 kΩ, output impedance of 20 kΩ and a transconductance of 50 mS. If a source with a source impedance of 10 kΩ is connected to this amplifier and it drives a load of 5 kΩ, what is the effective transconductance of this circuit?

4. A BJT is biased with $V_{BE} = 0.72\ V$ $I_S = 5 \times 10^{-15}\ A$. A sinusoidal signal with an amplitude of 2mV is added to the DC signal.

(i) Using the exponential expression, calculate the maximum & minimum collector current due to the applied sinusoid

(ii) Using the small signal approximation, (g_m) calculate the max. & min collector current due to the applied sinusoid.

Compare both answers.

5. A Common emitter amplifier is designed with a transistor $\beta = 200$, $R_C = 5k\Omega$, $V_{CC} = 15V$ and $I_C = 1.5mA$. DC biasing is done through a fixed bias with $R_B = 50k\Omega$. A source with a source impedance of 500Ω is connected to this amplifier. A load of $10k\Omega$ is connected to this amplifier.

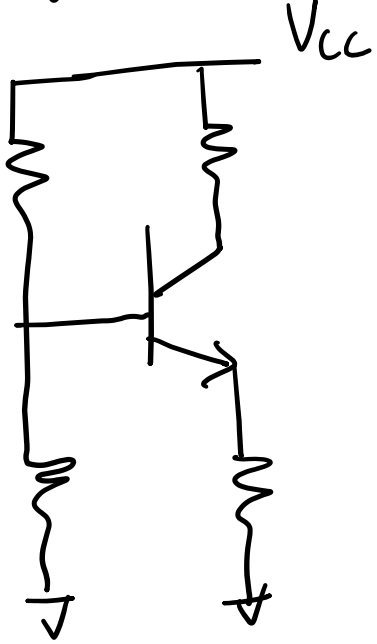
(i) Draw the complete circuit. Add capacitors where necessary.

(ii) Draw the small signal equivalent circuit

(iii) Calculate the input impedance

(iv) Calculate the overall gain.

6. Consider the following transistor which is appropriately biased.



(i) Connect input & output such that it is a Common Base amplifier

(ii) Connect input & output to make a Common collector amplifier.

7. A current amplifier drives a load of 5 kΩ is driven by a current sensor with 30 kΩ impedance and gives an overall current gain of 50 A/A. What is the intrinsic current gain of the amplifier if its $R_{in} = 100\,\Omega$ and $R_{out} = 100\,k\Omega$