Tutorial-5

1)- Common Emitter

$h_{re} = 10\times10^{-4}$, $h_{ie} = 1k\Omega$, $h_{fe} = 50$

$h_{oe} = 100\mu mhos$, $R_L = 1k\Omega$, $R_S = 1k\Omega$

i)- $R_I = h_{ie} - \frac{h_{fe}\times h_{re}}{h_{oe}\times\frac{1}{R_L}} = \frac{10^3 - 50\times10^{-3}}{10^{-4}+\frac{1}{10^3}}$

$\Rightarrow R_I = \underline{954.55\Omega}$

ii)- $Y_o = h_{oe} - \frac{h_{fe}\times h_{re}}{h_{ie}+R_S}$

$\Rightarrow Y_o = 5\times10^{-5}$ mhos

$\Rightarrow R_o = \frac{1}{Y_o} = \underline{20k\Omega}$

iii)- Current gain

$A_I = -\frac{h_{fe}}{1+h_{oe}\times R_L} = \frac{-50}{1+(10^{-4}\times10^3)} \Rightarrow A_I = \underline{-45.45}$

Voltage gain

$A_v = A_I\frac{R_L}{R_I} = \underline{47.61}$

approx $A_v = \frac{-h_{fe}R_L}{h_{ie}}$, $\frac{A_o R_{is}}{R_S+R_{is}} = \underline{-22.8}$

2)- Given, CE configuration

$h_{ie} = 1.1k\Omega$, $h_{re} = 2.5\times10^{-4}$, $h_{fe} = 50$, $h_{oe} = 25\mu$siemens

$r_s = r_L = 1k\Omega$

Current Gain, $A_I = \frac{-50}{1+25\times10^{-6}\times10^3} = \underline{-48.78}$

$R_I = 1.1\times10^3 - \frac{50\times2.5\times10^{-4}}{25\times10^{-6}+\frac{1}{10^3}}$

$\Rightarrow R_I = 1087.805\Omega$

Voltage gain

$$A_v = \frac{-48.78 \times 10^3}{1087.805} = -44.84$$

3)- CE transistor amplifier

$R_c = 4k\Omega$, $R_s = 40k\Omega$, $R_b = 10k\Omega$, $h_{fe} = 50$, $h_{re} \approx 0$, $h_{oe} \approx 0$ and $h_{ie} = 1100\Omega$

Voltage Gain → ?

Current Gain, $A_I = \frac{-h_{fe}}{1+0+0} = -50$

$R_L = R_c = 4k\Omega$

$R_I = h_{ie} - 0 = 1100\Omega$

$\Rightarrow A_v = -50 \times \frac{4 \times 10^3}{1100} = -181.81$

$R_o = \frac{1}{Y_o} = \frac{1}{h_{oe} - \frac{h_{fe} \times h_{re}}{h_{ie} + R_s}} = \infty$

4)- Common base amplifier

$h_{ib} = 28\Omega$, $h_{fb} = -0.98$, $h_{rb} = 5 \times 10^{-4}$, $h_{ob} = 0.34 \times 10^{-6} S$

$R_L = 1.2k\Omega$, $R_s = 0$

$$R_I = h_{ib} - \frac{h_{fb} h_{rb}}{h_{ob} + \frac{1}{R_L}} = 28 - \frac{(-0.98 \times 5 \times 10^{-4})}{0.34 \times 10^{-6} + \frac{1}{1.2 \times 10^3}}$$

$R_I = 0.587 = 28.587\Omega$

$$R_o = \frac{1}{Y_o} = \frac{1}{h_{ob} - \frac{h_{fb} h_{rb}}{h_{ib} + R_s}} = \frac{1}{1.784 \times 10^{-5}} \approx 56k\Omega$$

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Current Gain

$$A_I = \frac{-h_{fb}}{1 + h_{ob}R_L} = \frac{-(-0.98)}{1 + 0.34\times10^{-6} \times 1.2\times10^{3}}$$

$$A_I \cong 0.98$$

Voltage Gain $A_v = A_I \times \frac{R_L}{R_I} = 41.12$