Tutorial-I Problems

① A CE transistor amplifier is derive by a voltage V_s of interna resistance $R_s = 800\Omega$ The load impedance is a resistor $R_L = 2000$ The parameters are $h_{ie} = 1100\Omega$, $h_{re} = 2.5\times10^{-4}$, $h_{fe} = 50$, $h_{oe} = 2$ Compute the current gain A_I, voltage gain A_V, overall current gain overall voltage gain A_{VS}, input impedance R_i, output impeda Z_o, and the operating power gain A_p.

Sol:- Current gain $A_I = \frac{-h_{fe}}{1+h_{oe}\cdot R_L} = \frac{-50}{1+(25\times10^{-6})\times2000} = -47.6$

Input impedance $R_i = h_{ie} + h_{re} A_I R_L = 1100 + (2.5\times10^{-4})(-47.4)2000 =$

Voltage gain $A_V = \frac{A_I R_L}{R_i} = \frac{-47.6 \times 2000}{1076} = -88.47$

Overall voltage gain $A_{VS} = \frac{A_V R_i}{R_i + R_S} = \frac{(-88.47)\times1076}{1076+800} = -50.75$

Overall Current gain $A_{IS} = \frac{A_I R_S}{R_i + R_S} = \frac{-47.6\times800}{10.76+800} = -20.30$

output admittance $Y_0 = h_{oe} - \frac{h_{fe}h_{re}}{h_{ie}+R_S}$

$= (25\times10^{-6}) - \frac{50\times2.5\times10^{-4}}{(1100+800)} = 18.42\times10^{-6}$

Hence $Z_0 = \frac{1}{Y_0} = \frac{10^6}{18.42} = 0.0543\times10^6\Omega = 54.310\Omega$

Power gain $A_p = A_V \cdot A_I = 88.47\times47.6 = 4211$

A transistor in CB configuration is driven by a voltage source V_S of internal resistance $R_S = 800\Omega$, The load impedance is a resistor $R_L = 2000\Omega$. The h-Parameters are $h_{ib} = 22\Omega$, $h_{rb} = 3\times10^{-4}$ $h_{fb} = -0.98$ and $h_{ob} = 0.5\,\mu A/V$. Compute the current gain A_I, input resistance R_i, Voltage gain A_V, overall voltage gain A_{VS}, overall current gain A_{IS}, output impedance Z_0 & operating power gain A_P

Current gain $A_I = \dfrac{-h_{fb}}{1+h_{ob}\cdot R_L} = \dfrac{-(-0.98)}{1+(0.5\times10^{-6})\times2000} = 0.98$

Input impedance $R_i = h_{ib} + h_{rb}\cdot A_I\cdot R_L = 22 + 3\times10^{-4}\times0.98\times2000$

$= 22.59\Omega$

Voltage gain $A_V = \dfrac{A_I\cdot R_L}{R_i} = \dfrac{0.98\times2000}{22.59} = 86.78$

Overall voltage gain $A_{VS} = \dfrac{A_V\cdot R_i}{R_i + R_S} = \dfrac{86.78\times22.59}{22.59+800} = 2.383$

Overall current gain $A_{IS} = \dfrac{A_I\cdot R_S}{R_i+R_S} = \dfrac{0.98\times800}{22.59+800} = 0.953$

Output admittance $Y_0 = h_{ob} - \dfrac{h_{fb}\cdot h_{rb}}{h_{ib}+R_S}$

$= (0.5\times10^{-6}) - \dfrac{(-0.98)\times3\times10^{-4}}{22+800} = 0.8576\times10^{-6}S$

Hence $Z_0 = \dfrac{1}{Y_0} = \dfrac{10^6}{0.8576}\Omega = 1.166\times10^6\Omega$

Power gain $A_P = A_V\cdot A_I = 86.78\times0.98 = 85.04$.

3) A CC transistor amplifier is driven by a voltage source of internal resistance $R_S = 800\Omega$. The load impedance is a resis $R_L = 2000\Omega$. The h-Parameters are $h_{ic} = 1100\Omega$, $h_{rc} = \frac{1}{1100}$, $h_{fc} = -51$ & $h_{oc} = 25\mu A/V$. Compute A_I, R_i, A_V, A_{VS}, A_{IS}, Z_o, A_p.

Current gain $A_I = \frac{-h_{fc}}{1+h_{oc}R_L} = \frac{-(-51)}{1+(25\times10^{-6}\times2000)}$

$= \frac{51}{1.05} = 48.57$

Input impedance $R_i = h_{ic} + h_{rc} \cdot A_I \cdot R_L$

$= 1100 + (1+48.57*2000) = 98,240\Omega$

Voltage gain $A_V = \frac{A_I \cdot R_L}{R_i} = \frac{48.57\times2000}{98,240} = 0.9888$

Overall voltage gain $A_{VS} = \frac{A_V \cdot R_i}{R_i + R_S} = \frac{0.988\times98,240}{98,240+800} = 0.981$

overall current gain $A_{IS} = \frac{A_I \cdot R_S}{R_i + R_S} = \frac{48.57\times800}{98,240+800} = 0.3923$

output admittance $Y_o = h_{oc} - \frac{h_{fc}\cdot h_{rc}}{h_{ic}+R_S}$

$= (25\times10^{-6}) - \frac{(-51)(1)}{1100+800} = 26.86\times10^{-3}S$

Hence output impedance

$Z_o = \frac{1}{Y_o} = \frac{10^3}{26.86}\Omega = 37.28\Omega$

Power gain $A_p = A_I \cdot A_V = 48.57\times0.9888 = 48.04$

Approximate Conversion Formulas for Hybrid Parameters

The expression for CE parameters interms of the CB parameters may be obtained from Table given below by interchanging the subscripts b & e

CE	CC	CB
h_{ie}	$h_{ic} = h_{ie}$	$h_{ib} = \frac{h_{ie}}{1+h_{fe}}$
h_{fe}	$h_{fc} = -(1+h_{fe})$	$h_{fb} = -\frac{h_{fe}}{1+h_{fe}}$
h_{re}	$h_{rc} = 1$	$h_{rb} = \frac{h_{ie} h_{oe}}{1+h_{fe}} - h_{re}$
h_{oe}	$h_{oc} = h_{oe}$	$h_{ob} = \frac{h_{oe}}{1+h_{fe}}$

Three derivation formulas
In exam CE, CB, CC formulas can be written as

CE	CB	CC
$A_I = \frac{-h_{fe}}{1+h_{oe}R_L}$	$A_I = \frac{-h_{fb}}{1+h_{ob}R_L}$	$\frac{-h_{fc}}{1+h_{oc}R_L}$

$$z_i = h_{ie} + h_{re} A_I Z_L$$

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

$$A_v = \frac{A_I Z_L}{z_i}$$

$$A_{vs} = \frac{A_v z_i}{z_i + R_s}$$

$$A_{Is} = \frac{A_{vs} R_s}{A_I} \quad \frac{A_I R_s}{z_i + R_s}$$