- Pole $\boldsymbol{p_1}$ ($\boldsymbol{p_2}$) is referred to as the pole of the ***input*** (***output***) circuit
- Also, $|p_1| << |p_2|$

  $\Rightarrow$ $\boldsymbol{p_1}$ ($\boldsymbol{p_2}$) is the ***DP*** (***NDP***) of the system
- ***Matching coefficients***:

$$p_1 = -\frac{R_S + r_\pi}{R_S r_\pi}\frac{1}{C_T} = -\frac{1}{\left(R_S \parallel r_\pi\right)\left[C_\pi + \left(1 + g_m R_L\right)C_\mu\right]}$$

$$p_2 = -\frac{1}{R_L C'_M}$$

- Obviously, $|p_1| << |p_2|$

- Thus, ***using DPA***: $f_H = |p_1|/(2\pi)$
- Applying ***this technique*** to the ***previous example***, $\boldsymbol{f_H = 3.9}$ ***MHz*** and ***NDP frequency = 156 MHz***
  - ***Error of only 2.6% in*** $\boldsymbol{f_H}$, but the ***ease of solution is much more***
- Thus, ***this technique*** is ***quite popular*** in getting a ***quick estimate*** of f_H, even though the ***solution*** may not be ***exact***
- ***Care***: ***The gain in the multiplicative factor is that between the input and output terminals of the capacitor***

- ***The Zero-Value Time Constant (ZVTC) Technique***:
  - ***Gives information only about the DP of the system***
  - ***Suppresses all information regarding other poles and zeros***
  - ***The ease of application of this technique is mind-boggling***

- ***Slightly less accurate***
- ***The maximum error can be as high as 22%***
- ***Underestimates f_H***
  - ***Far better than overestimation and eventually not achieving it***
- ***Applicable only for circuits that have a DP***
  - ***Fortunately, almost all analog circuits of interest do have a DP***

- ***The Algorithm***:
  - ***Null all independent sources to the circuit***
    - ***Short all independent voltage sources***
    - ***Open all independent current sources***
    - ***DO NOT TOUCH DEPENDENT SOURCES***
  - ***Name the capacitors C_i*** (***$i = 1\text{-}n$***)
  - ***Consider C_1 and assign zero values to all other capacitors*** (***thus the name***!)
    - Thus, ***except C_1***, ***all other capacitors will open out***
  - ***Determine the Thevenin Resistance*** $\left(R_1^0\right)$ ***across the two terminals of C_1***

- ***Find the time constant τ_1 associated with C_1***
  $\left(\tau_1 = R_1^0 C_1\right)$
- ***Repeat for all other capacitors***, ***taking one at a time***, and ***find all the rest of the time constants*** $(\tau_2, \tau_3, \ldots, \tau_n)$
- Determine the ***net time constant*** τ_{net} by ***summing up*** all the ***individual time constants***

$$\Rightarrow \tau_{net} = \sum_{i=1}^{n} \tau_i$$

- Then the ***Upper Cutoff Frequency*** f_H is simply given by: $f_H = 1/(2\pi\tau_{net})$

- ***Note***: ***The capacitor contributing the largest time constant, in effect, determines f_H***
- ***The technique suppresses all information regarding other poles and zeros***
- Will present ***several examples*** to understand the ***application*** of this ***technique***
- Some ***topologies*** will be appearing ***frequently***, known as ***Standard Forms***, which can be treated as ***individual modules***, and the ***results can be used freely***