Tutorial-8 Solutions

S-2

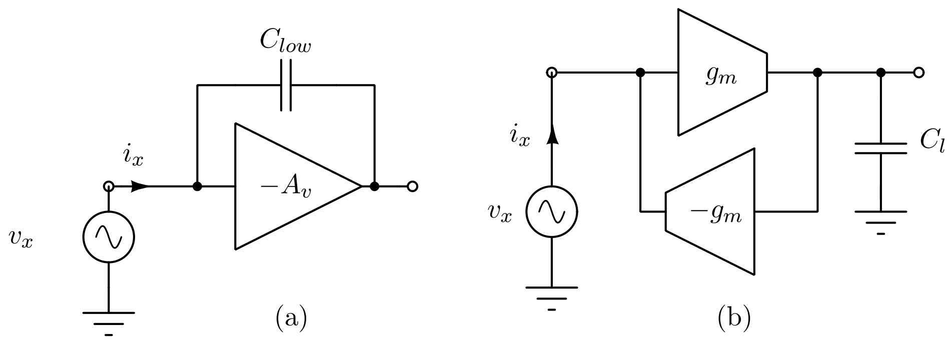

Figure 1: (a) Miller multiplier (b) Impedance inverter

To find out the input impedance, let us apply a known voltage source v_x and find out the current drawn from it i_x.

(i) Voltage across the capacitor $= v_{in} - v_{out} = (1 + A_v)v_x$

Current flowing through the capacitor $i_x = \frac{(1+A_v)v_x}{1/sC_{low}} = s(1 + A_v)C_{low}v_x$

Input impedance $= \frac{v_x}{i_x} = \frac{1}{s(1+A_v)C_{low}}$

Model: A grounded capacitor (i.e., one terminal of the capacitor is connected to ground) with a capacitance of $(1 + A_v)C_{low}$

Observation: A small capacitance C_{low} is used to realize a large capacitance $(1 + A_v)C_{low}$

(ii) Current flowing into the load capacitance $C_l = g_m v_x$

Voltage across $C_l = \frac{g_m v_x}{sC_l}$

Output current of $-g_m = -i_x = -g_m(\frac{g_m v_x}{sC_l})$

Input impedance $= \frac{v_x}{i_x} = \frac{sC_l}{g_m^2}$

Model: A grounded inductor (i.e., one terminal of the inductor is connected to ground) with an inductance value of $\frac{C_l}{g_m^2}$

Observation: An inductor is realized using only capacitors and transconductors.

S-3:

(a). V_{cn}, is the phase voltage.

So, V_{cn}=$\frac{400}{\sqrt{3}}\angle-270^0 = 230.94\angle-270^0$ V

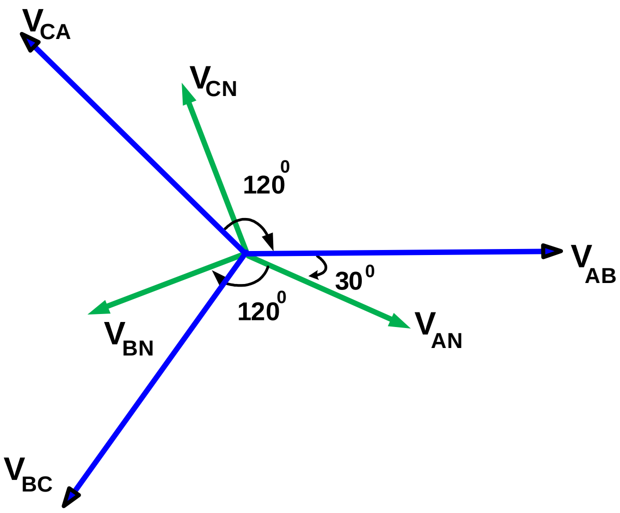

Fig.S3

s

(b). $Z_{AN} = (-j100)||(100)||(50+j50)$

$$= \frac{-j100\times100\times(50+j50)}{-j100\times100+100(50+j50)-j100\times(50+j50)} = 50\ \Omega$$

$$I_{aA} = \frac{230.94\angle-30^0}{50} = 4.62\angle-30^0 \text{ A}$$

(c). Real power drawn by the load is = $3\times V_{ph}\times I_{ph}$ = 3.2 kW

S-4:

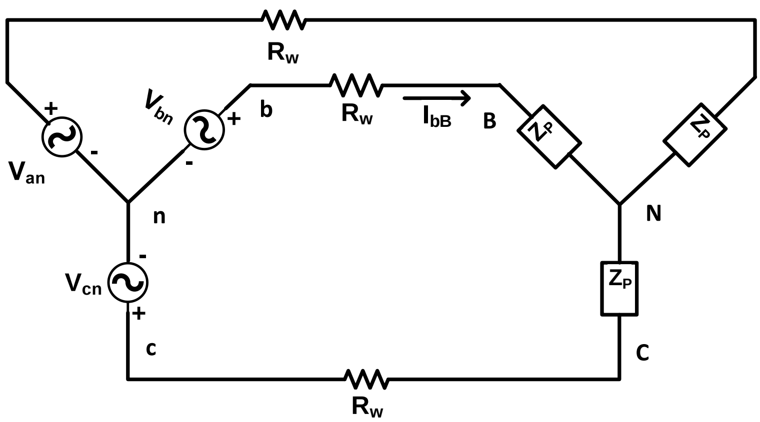

Fig.S4

(a) $Z_P = 12 + j5\ \Omega$

$I_{bB} = 20\angle0^0$

$P.F.angle = \cos^{-1}(0.935) = 20.770°$

$\tan^{-1}\left(\frac{5}{12+R_w}\right) = 20.77^0 \;\Rightarrow\; \frac{5}{12+R_w} = 0.38 \;\Rightarrow 13.18 = 12 + R_w \;\Longrightarrow R_w = 1.18\,\Omega$

(b) $V_{bn} = I_{bB}(Z_P + R_W) = 20\angle 0^0\ (12 + j5 + 1.18)$ = $20\ (13.18\ + j5)$

$= 263.6 + j\ 100 = 282\angle 20.77^0$ V

(c) $V_{bc} = \sqrt{3}\ \times 282\angle(20.77^0 + 30^0)$ = $488.44\angle 50.77^0$ V *and*,

$V_{ab} = 488.44\angle 170.77^0$ V

(d) Total complex power supplied by the source = $3V_{bn}I_{bB}^{*} = 16.92\angle 20.77^0$ KVA