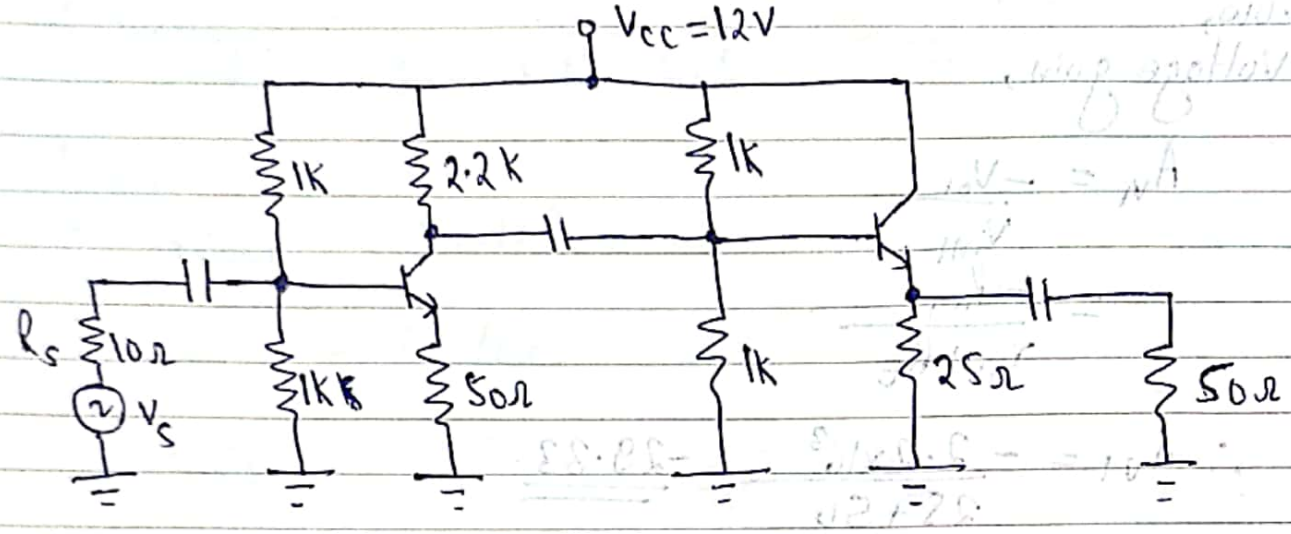
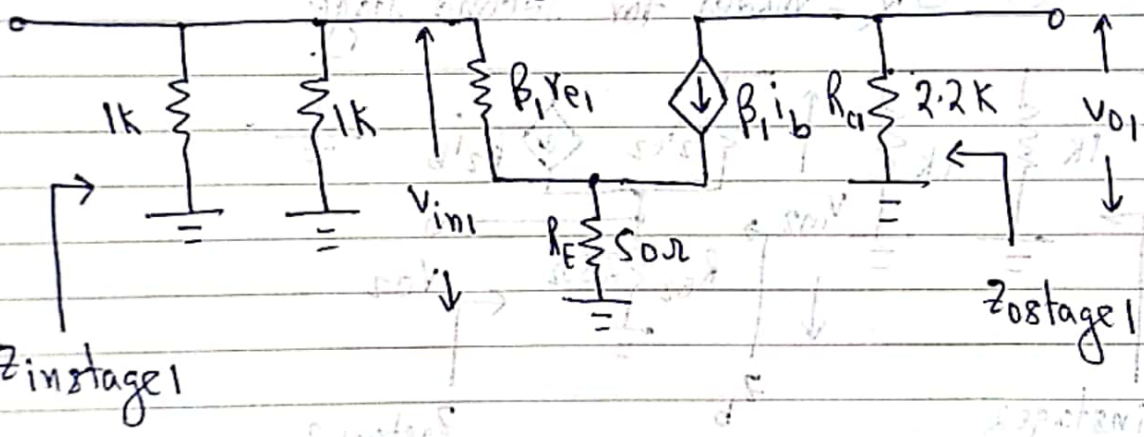
DATE: No.

1) Find overall voltage gain (V_L/V_s) and overall current gain (i_L/i_s) in dB for the cascaded BJT amplifier shown below. (Assume $r_{e1} = r_{e2} = 25\Omega$ & $\beta_1 = \beta_2 = 100$)



Soln Here,

r_e-model for first stage,



Now,

$$Z_{in\,stage1} = 1K // 1K // \beta_1 (r_{e1} + R_E)$$

$$= 1K // 1K // 100\left(\frac{25}{1000} + \frac{50}{1000}\right)$$

$$= 1K // 1K // 7.5K$$

$$\therefore Z_{in\,stage1} = \frac{1 \times 1 \times 7.5}{1 \times 1 + 1 \times 7.5 + 1 \times 7.5} = \underline{\underline{0.468K}}$$

DATE: No.

Again,
$z_{ostage1} = \underline{\underline{2.2K}} \Rightarrow R_{C1}$

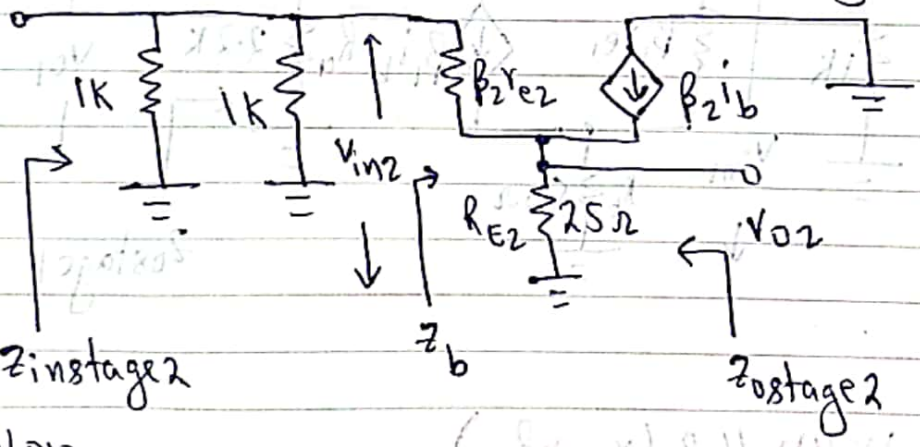
Now,
Voltage gain,

$$A_{v1} = \frac{-V_{o1}}{V_{in1}}$$

$$= \frac{-R_{C1}}{r_{e1}+R_E}$$

$$\therefore A_{v1} = -\frac{2.2\times10^3}{25+50} = \underline{\underline{-29.33}}$$

~~Voltage~~ Again,
r_e - model for second stage



Now,
$z_{instage2} = 1K // 1K // z_b$

where,
$z_b = \beta_2(r_{e2}+R_{E2})$

$$= 100\left(\frac{25}{1000}+\frac{25}{1000}\right)$$

$\therefore z_b = 5K$

DATE: No.

Hence,

$z_{instage2} = 1K//1K//5K$

$\therefore z_{instage2} = \frac{1\times1\times5}{1\times1+1\times5+1\times5} = \underline{0.454K}$

Again,

$z_{ostage2} = r_{e2}//R_{E2}$

$= 25//25$

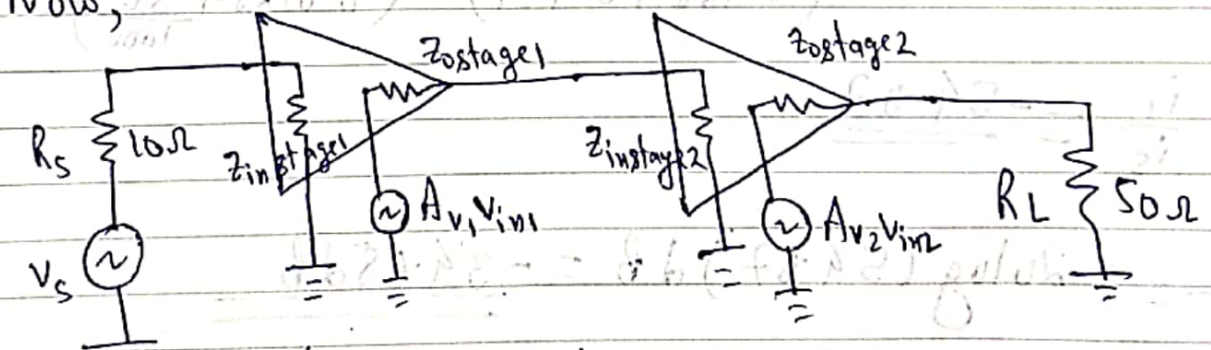
$\therefore z_{ostage2} = 12.5\,\Omega = \underline{0.0125K}$

Now, voltage gain;

$A_{v_2} = \frac{R_{E2}}{r_{e2}+R_{E2}}$

$\therefore A_{v_2} = \frac{25}{25+25} = \underline{0.5}$

Now,



Overall voltage gain ($A_{vs} = v_L/v_S$)

$$v_L/v_S = \left(\frac{z_{instage1}}{R_S + z_{instage1}}\right) \times A_{v_1} \times \left(\frac{z_{instage2}}{z_{ostage1} + z_{instage2}}\right) \times A_{v_2} \times \left(\frac{R_L}{z_{ostage2} + R_L}\right)$$

DATE: No.

$$\text{or, } \frac{V_L}{V_S} = \frac{0.468}{\left(\frac{10}{1000}+0.468\right)} \times (-29.33) \times \left(\frac{0.454}{2.2+0.454}\right) \times (0.5) \times \frac{(50/1000)}{\left(0.0125+\frac{50}{1000}\right)}$$

$$\therefore \frac{V_L}{V_S} = \underline{\underline{-1.964}}$$

$$\therefore \frac{V_L}{V_S} = -20\log(1.964)\,dB = \underline{\underline{-5.86\,dB}} \Rightarrow A_{VS}$$

Again,

Overall current gain ($A_{is} = i_L/i_s$)

$$\frac{i_L}{i_s} = A_{v_1} \times A_{v_2} \times \left(\frac{Z_{instage1}}{Z_{instage1}+Z_{instage2}}\right) \times \left(\frac{Z_{instage2}}{Z_{ostage2}+R_L}\right)$$

$$= -29.33 \times 0.5 \times \left(\frac{0.468}{0.468+0.454}\right) \times \left(\frac{0.454}{0.0125+\frac{50}{1000}}\right)$$

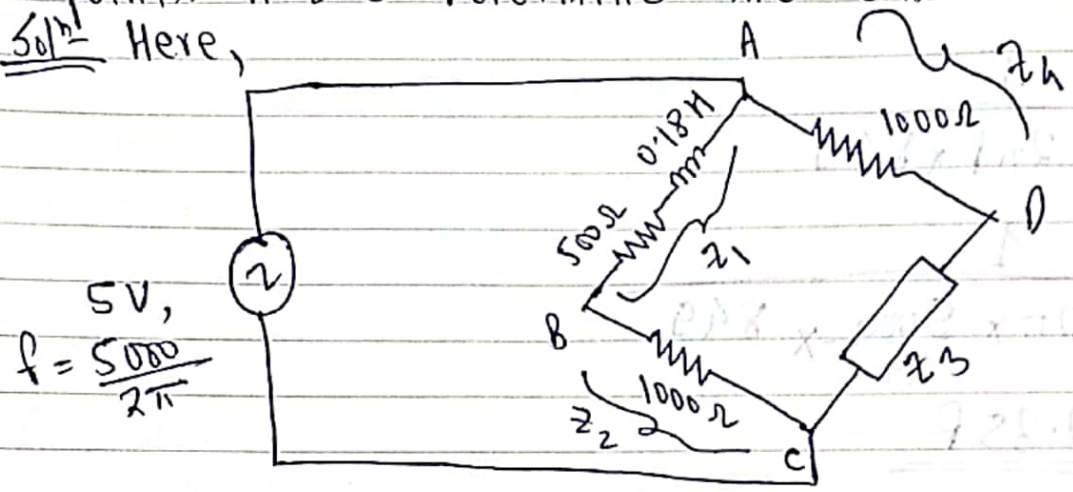
$$\therefore \frac{i_L}{i_s} = \underline{\underline{-54.07}}$$

$$\therefore \frac{i_L}{i_s} = -20\log(54.07)\,dB = \underline{\underline{-34.65\,dB}}$$

DATE: No.

2) In a balanced network, arm AB consist of a resistance of 500Ω in series with an inductor of 0.18H, arm BC and arm DA are non-inductive resistances of 1000Ω each and arm CD is unknown. A potential difference of 5V at a frequency $5000/2\pi$ is applied between points A & C. Determine the constants of unknown arm.

Sol^n Here,



Now, $Z_1 = R + j\omega L = 500 + j2\pi f L$

or, $Z_1 = 500 + j2\pi \times \frac{5000}{2\pi} \times 0.18$

$\therefore Z_1 = 500 + j900 = \underline{1029.56 \angle 60.94}$

$Z_2 = 1000\Omega = 1000 \angle 0$

$Z_3 =$ unknown

$Z_4 = 1000\Omega = 1000 \angle 0$

we know,

At balance condition,

$Z_1 Z_3 = Z_2 Z_4$

$\therefore Z_3 = \frac{Z_2 Z_4}{Z_1} = \frac{(1000 \angle 0)(1000 \angle 0)}{1029.56 \angle 60.94}$

$\therefore Z_3 = 971.28 \angle -60.94 = \underline{(471.77 - j849)\Omega}$

DATE: No.

This unknown branch contains resistor & capacitor in series : where,

Resistance (R) = 471.77 Ω

Also,

$$X_C = \frac{1}{2\pi fc} = 849$$

comparing with,

$$Z_3 = R - jX_C$$

or, $$C = \frac{1}{2\pi f \times 849}$$

or, $$C = \frac{1}{2\pi \times \frac{5000}{2\pi} \times 849}$$

$$\therefore C = 2.35\,f$$

Hence,

unknown arm CD contains Resistor (R) = 471.77 Ω in series with capacitor (C) = 2.35 f