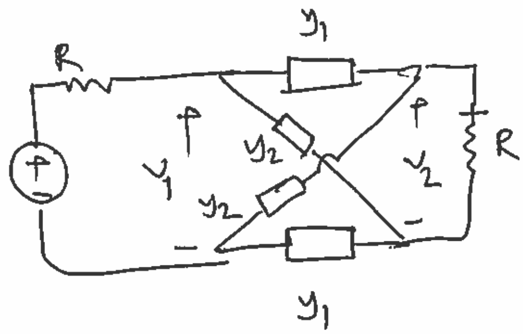
Arindam Mandal

Asst 3, Q.2

2)

a)



$$Y = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}$$

$$y_{in} = \frac{\det Y + y_L y_{11}}{y_L + y_{22}}$$

$$\det Y = y_{11} y_{22} - y_{12} y_{21}$$

$$= \left[(y_1 + y_2)^2 - (y_2 - y_1)^2\right] \frac{1}{4}$$

$$= y_1 y_2$$

$$y_{in} = y_L$$

$$y_{11} = y_{22}$$

$$y_L^2 = \det Y$$

$$y_L^2 = y_1 y_2$$

$$y_L = \sqrt{y_1 y_2}$$

$$y_2 = \frac{y_L^2}{y_1} = \frac{1}{R^2} \frac{1}{sC + \frac{1}{sL}} = \frac{1}{R^2} \frac{sL}{s^2LC + 1}$$

$$= \frac{1}{R^2} \frac{L/C}{sL + 1/sC}$$

$$= \frac{1}{sR^2C + \frac{1}{sL/R^2}}$$

$$\frac{v_2}{v_i} = \frac{y_1 - y_2}{2y_2 + (y_1 + y_2)}$$

$$= \frac{y_1 - y_L}{y_1 + y_L}$$

$$= v_1 = v_i \times \frac{y_{in}}{y_{in} + y_L} = \frac{v_i}{2}$$

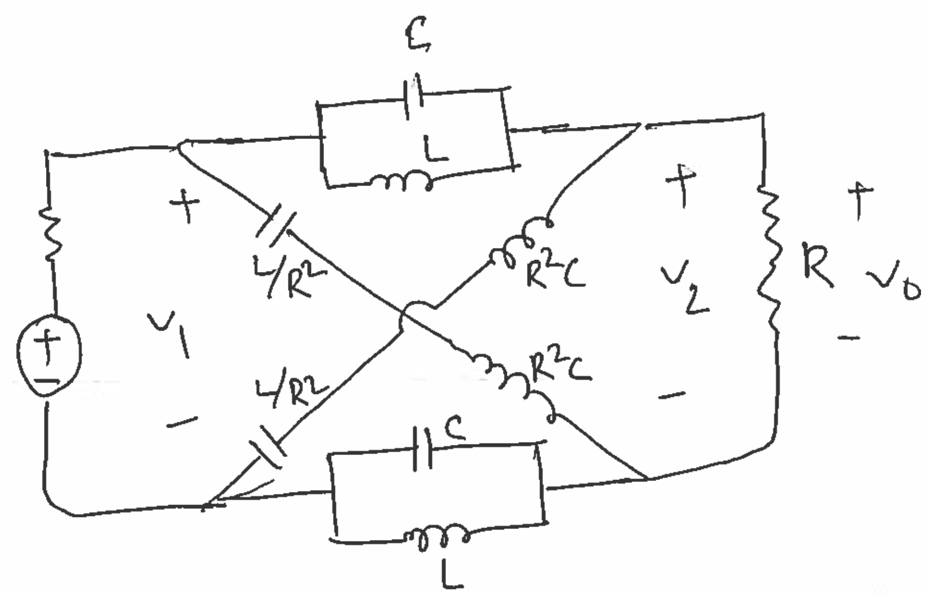
$$\frac{v_o}{v_i}(s) = \frac{1}{2}\,\frac{y_1 - y_L}{y_1 + y_L}$$

$$= \frac{1}{2}\,\frac{sC + \frac{1}{sL} - \frac{1}{R}}{sC + \frac{1}{sL} + \frac{1}{R}}$$

$$= \frac{1}{2}\,\frac{s^2LC + 1 - sL/R}{s^2LC + 1 + sL/R}$$

$$= \frac{1}{2}\,\frac{s^2 - s/RC + 1/LC}{s^2 + s/RC + \frac{1}{LC}}$$

b)



c).

$$\frac{v_o}{v_i}(s) = -\frac{1}{2}\;\frac{s^2 - s\frac{G}{C} + 1/LC}{s^2 + sG/C + \frac{1}{LC}}$$

poles $\rightarrow$ $-\frac{G}{2C} \pm \sqrt{\frac{G^2}{4C^2} - \frac{1}{LC}}$

zeros $\rightarrow$ $\frac{G}{2C} \pm \sqrt{\frac{G^2}{4C^2} - \frac{1}{LC}}$.

they are real for $\frac{G^2}{4C^2} \geq \frac{1}{LC}$

$\Rightarrow G^2 \geq \frac{4C}{L}$

double for $G^2 = \frac{4C}{L}$

d)

$C = 1nF$

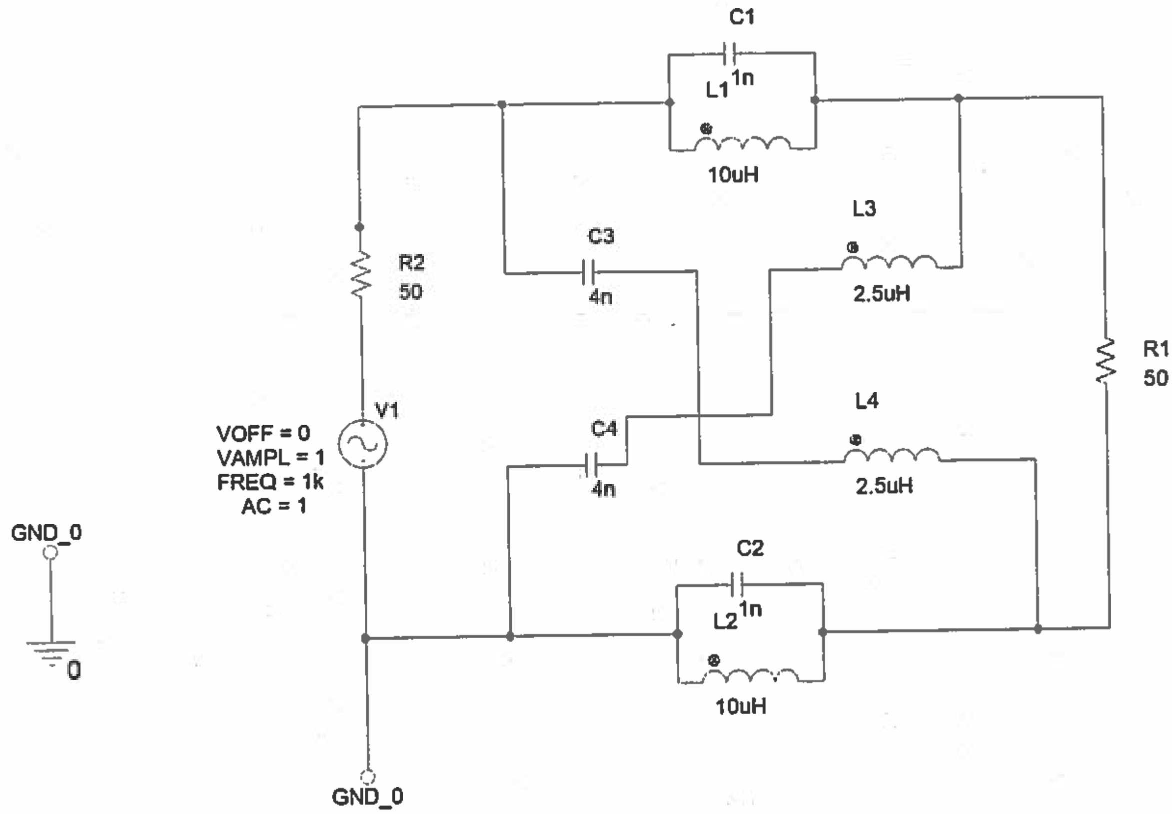
$L = 1\mu H \quad , R = 50\Omega$

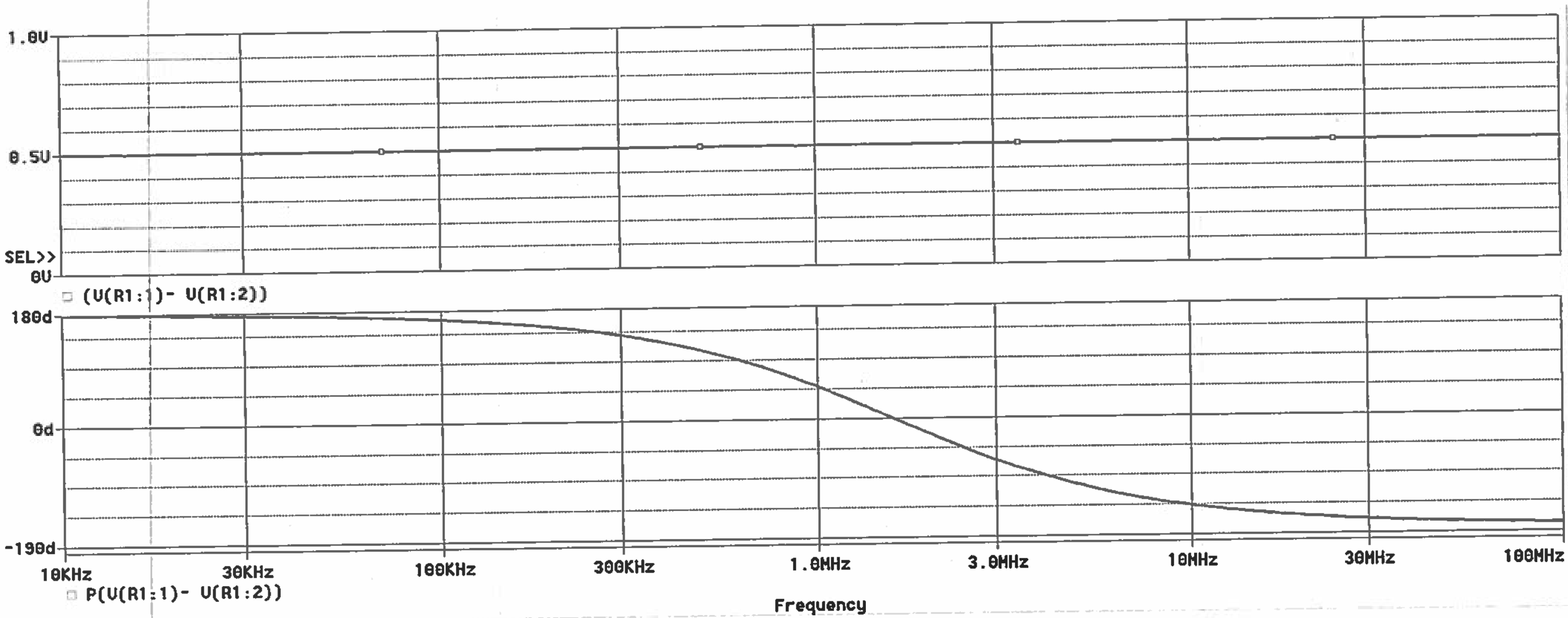
e)

$$\frac{V_2}{V_1} = \frac{y_1 - y_2}{2y_L + (y_1 + y_2)} = \frac{y_1 - y_L}{y_1 + y_L}$$

$$\frac{V_2(j\omega)}{V_1(j\omega)} = 1\, e^{-2j\tan^{-1}\left(\frac{B_1(\omega)}{y_L}\right)} \qquad y_1 = jB(\omega),$$

if 2 constant R lattices are cascaded then their magnitude remains same, but phase swing ~~is~~ doubles.


C1
1n
L1
10uH
L3
2.5uH
C3
4n
R2
50
R1
50
V1
VOFF = 0
VAMPL = 1
FREQ = 1k
AC = 1
C4
4n
L4
2.5uH
C2
1n
L2
10uH
GND_0
0
GND_0


1.0V
0.5V
SEL>>
0V
(V(R1:1)- V(R1:2))
180d
0d
-190d
10KHz
30KHz
100KHz
300KHz
1.0MHz
3.0MHz
10MHz
30MHz
100MHz
P(V(R1:1)- V(R1:2))
Frequency