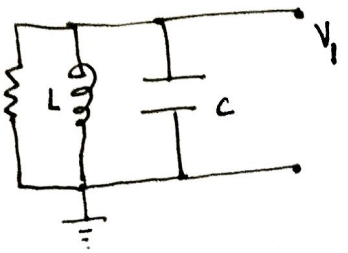
CIRCUITS

I Parallel RLC Resonator



$R = 20k\Omega$
$L = 8H$
$C = 0.125\mu F$

$V_2 = \frac{dV_1}{dt}$

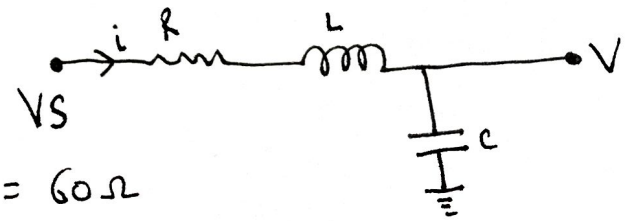
$\frac{dV_2}{dt} = -\frac{V_2}{RC} - \frac{V_1}{LC}$

$V_1(0) = 0\ V$

$\left.\frac{dV_2}{dt}\right|_{t=0} = 1\ V/s$

Resonant frequency = 159.15 Hz

II Low-Pass Filter



$R = 60\Omega$
$L = 0.27H$
$C = 47\mu F$
$VS = \sin(2\pi \cdot 20t) + \sin(2\pi \cdot 500t) + \sin(2\pi \cdot 140t)$

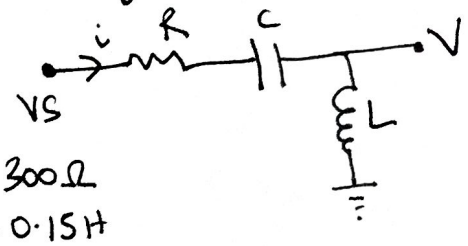
$\frac{di}{dt} = (VS - V - iR)/L$

$\frac{dV}{dt} = \frac{i}{C}$

$V(0) = 0$
$i(0) = 0$

Cut-off frequency = 44.67 Hz

III High-Pass Filter



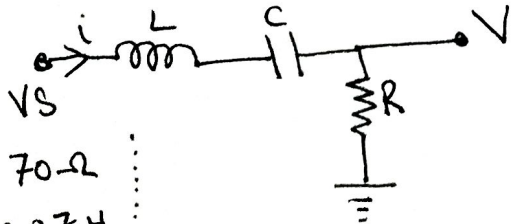
$R = 300\Omega$
$L = 0.15H$
$C = 1\mu F$
$VS = \sin(2\pi \cdot 10t) + \sin(2\pi \cdot 500t)$

$i_1 = \frac{di}{dt}$; $V_1 = \frac{dV}{dt}$

$\frac{di_1}{dt} = \frac{V_1}{L}$; $\frac{dV_1}{dt} = \frac{d^2VS}{dt^2} - \frac{i_1}{C} - \frac{RV_1}{L}$

Cut-off frequency = 410.94 Hz

IV Band-Pass Filter



$R = 70\Omega$
$L = 0.27H$
$C = 4.7\mu F$
$VS = \sin(2\pi \cdot 10t) + \sin(2\pi \cdot 500t) + \sin(2\pi \cdot 140t)$

$i_1 = \frac{di}{dt}$; $V_1 = \frac{dV}{dt}$; $\frac{di_1}{dt} = \left(\frac{dVS}{dt} - V_1 - \frac{i}{C}\right)/L$

$\frac{dV_1}{dt} = \frac{R}{L} \times \left(\frac{dVS}{dt} - V_1 - \frac{i}{C}\right)$

Center-frequency = 141.28 Hz