Aim : To study the frequency response of the LCR circuit using simulation.

Theory :

LCR frequency response: The LCR circuit consist of inductor , capacitor and resistor and there is net impedance which is frequency dependent and it a certain frequency the impedance is very low for a resonant frequency and the current is maximum at this frequency .

$$Z = \sqrt{\left(R^2 + \left(X_L - X_C\right)^2\right)}$$

$$I = \frac{V}{Z} = \frac{V}{\sqrt{\left(R^2 + \left(X_L - X_C\right)^2\right)}}$$

$$X_L = \omega * L \text{ and } X_C = \frac{1}{\omega * C}$$

here L is inductance and C is capacitance"

$$Reasonat\ frequency\ , \omega_0 = \frac{1}{\sqrt{(L * C)}}$$

Algorithm :

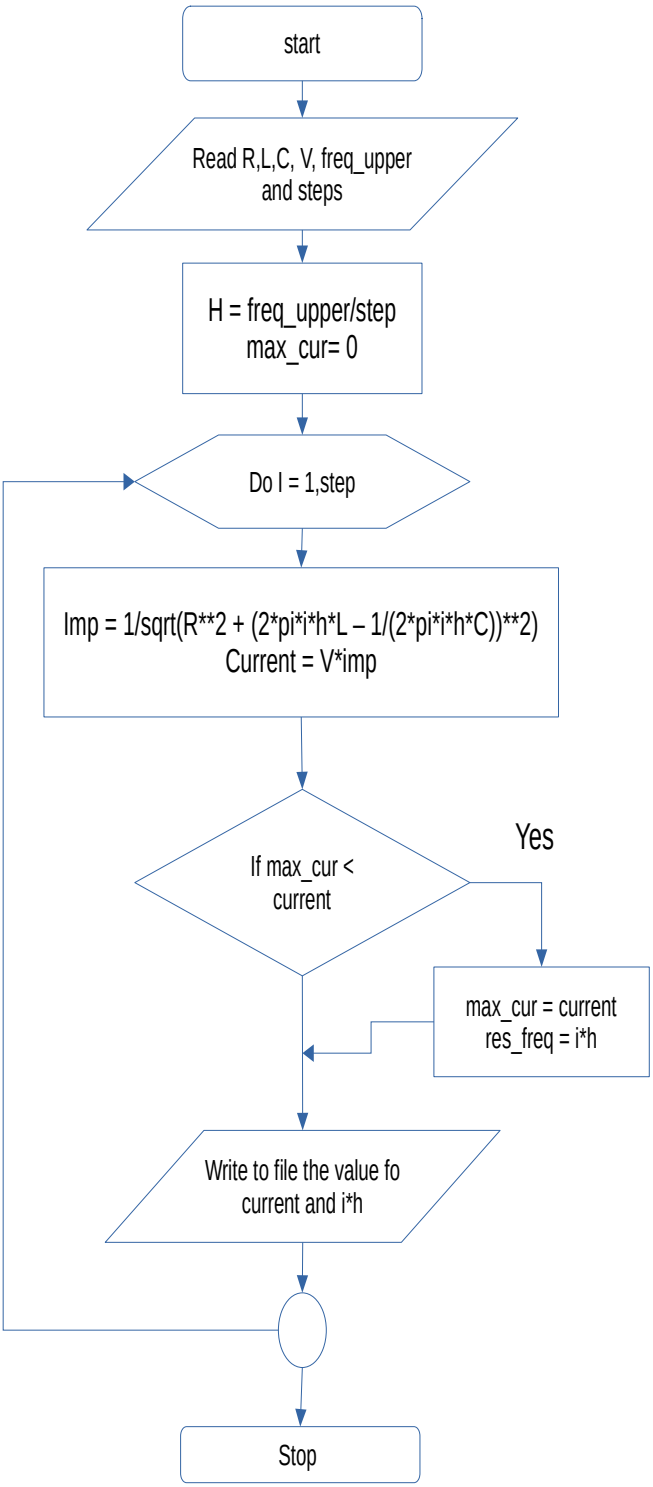
For simulation of frequency response of LCR circuit we first getting the value of resistance , capacitance , inductance and voltage of the LCR circuit from the user and getting the upper bound of the frequency and step size from the user.
And then calculating the current for the formula for every frequency step and save the value to the file and also getting the value of the maximum current and its corresponding frequency.
And that's how we can study the frequency response of the LCR circuit.

Program in FORTRAN 95:

```
program main
   implicit none ! declaring the variables
   real :: resistance , inductance , capacitance , inv_imp , freq_lower , freq_upper , step
   real :: resonate_freq , voltage , current , high_current , cal_resonate
   integer :: step_num , i
   real , parameter :: pi = 3.14159265
   logical :: f1
! getting the value of resistance , inductor and capacitance from the user
   print *, "Enter the value of resistance : "
   read *, resistance
   print *, "Enter the value of inductance (in mH): "
   read *, inductance
   print *, "Enter the value of capacitance (in mF): "
   read *, capacitance
   print *, "Enter the value of voltage (in Volt): "
   read *,voltage
! getting the frequency value form the user
```

```
   print *, "Enter the lower limit of frequency : "
   read *, freq_lower
   print *, "Enter the upper limit of frequency : "
   read *, freq_upper
   print *, "Enter the step taken to from lower frequency to upper frequency : "
   read *, step_num

   step = (freq_upper - freq_lower)/(real(step_num)) ! calculating the steps for frequency

   inductance = inductance/1000 ! convert them into mH and mF

   capacitance = capacitance/1000

   cal_resonate = 1/(2*pi*sqrt(inductance*capacitance)) ! calculating the resonant from formula

   !check exiting file and open it and if file doesn't exit then create the files

   inquire(file="freq_response.dat",exist=f1) ! for checking the existence of the file
   if (f1) then
      open(1,file="freq_response.dat",status="replace")
   else
      open(1,file="freq_response.dat",status="new",action="write")
   endif
   high_current = 0.0

   do i = 0,step_num ! creating the frequency response of LCR circuit
      inv_imp = 1/sqrt(resistance**2 + (2*pi*(freq_lower + i*step)*inductance -
1/(2*pi*(freq_lower + i*step)*capacitance))**2)
      current = inv_imp*voltage
      write(1,*)freq_lower+i*step,current
      if(current > high_current) then ! calculating the resonant frequency from the graph
         high_current = current
         resonate_freq = freq_lower + i*step
      endif
   enddo
   close(1)

   print *, "Simulation complete"
   print *, ""
! printing the output
   if (cal_resonate > freq_upper) then
      print *, "Resonate frequency is higher than the upper limit of frequency"
   else
      print *, "Resonate Frequency is " ,resonate_freq, "and current for ",voltage,"V is
",high_current
   endif
   stop
end program
```

Flow chart :


start
Read R,L,C, V, freq_upper and steps
H = freq_upper/step
max_cur= 0
Do I = 1,step
Imp = 1/sqrt(R**2 + (2*pi*i*h*L – 1/(2*pi*i*h*C))**2)
Current = V*imp
If max_cur < current
Yes
max_cur = current
res_freq = i*h
Write to file the value fo current and i*h
Stop

Output:

Enter the value of resistance :
0.2
Enter the value of inductance (in mH):
0.93
Enter the value of capacitance (in mF):
0.4
Enter the value of voltage (in Volt):
12
Enter the lower limit of frequency :
0
Enter the upper limit of frequency :
1500
Enter the step taken to from lower frequency to upper frequency :
1000000
Simulation complete

Resonate Frequency is 260.941498 and current for 12.0000000 V is 60.0000000 A

Result :