Name:

Danny Mizhquiri	Kunal Surujprasad	Damian Brathwaite	Benjamin Yusufov	Luijen Payano	Javier Bonilla	Ameer Shadick	Ebtida Ahmed	Maharin Khondoker
John Villalona		Javier Garcia				Kevin Jaisingh		Atta Tariq

Lesson: RLC Circuit Project 2 Part 2 MAT 2680 D772

Real-World Purpose:

An example of a real-world RLC circuit can be a radio receiver circuit, which many of the students in this Math Class 2680 have taken a class (computer engineer students) similar to radio receivers. In a radio receiver, the incoming radio frequency signal is filtered by an RLC circuit to extract the desired frequency, and there are mathematical components in frequency that are used like a Linear question. The RLC circuit consists of a resistor (R), an inductor (L), and a capacitor (C) connected in series or parallel. The resistor is used to dissipate energy, the inductor stores energy in a magnetic field, and the capacitor stores energy in an electric field.

The behavior of the RLC circuit can be described by a second-order linear differential equation, which was mentioned before. There is a third and more order, but we will stick to second-order. This equation relates the voltage across the circuit components to the current flowing through them. The equation takes the form of a homogeneous differential equation:

$L\, d^2i/dt^2 + R\, di/dt + 1/C\, i = 0$

where L is the inductance, R is the resistance, C is the capacitance, i is the current, and t is time.

Solving this differential equation can be done by assuming a solution of the form $i = Ae^{(st)}$, where A and s are constants. Substituting this solution into the differential equation results in a characteristic equation:

$Ls^2 + Rs + 1/C = 0$

The answers to this equation govern how the RLC circuit will operate. If the characteristic equation's roots are real and negative, the circuit is overdamped, and the current gradually decreases until it is zero. When the circuit is underdamped and the roots are complex conjugates with a negative real portion, the current oscillates around zero before degenerating. The circuit is critically damped if the roots are real and equal. An example of solving an RLC circuit differential equation can be found at https://www.electronics-tutorials.ws/accircuits/series-circuit.Series RLC Circuit Analysishtml.

RLC Circuit Explanation & Using:

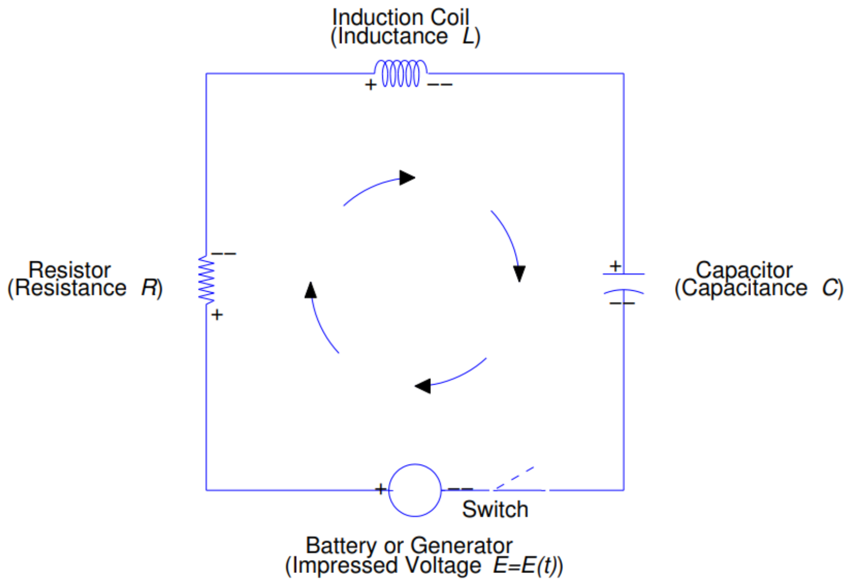

Figure 6.3.1 An *RLC* circuit

According to the textbook in Chapter 6.3, the RLC circuit form describe as a spring-mass system with damping that is capable of transferring the electrical charge known as current around the circuit. Furthermore, as the circuit formation is closed, meaning that it creates a electrical potential Voltages E = E(t) in different varieties, since it depends on the amount between positive and negative terminal. As such it Form E(t) > 0, E(t) < 0, and E(t) = 0. In addition the t itself respsent the current flow follow depending what direction that given the amounts of positive and negative terminal. It is indicated if the I(t) > 0, I(t) < 0, and I(t) = 0 are the result if the direction follow the standard, opposite and no positive and negative terminal flow. From there, there other components that Voltage drop occur at the Resistor, Capacitor and Inductor.

Voltage drop is Potential difference of positive terminal and negative terminal of the component.
In Voltage drop across on:
Resistor
V_R =IR
Where I is current through Resistor R
V_I=L dI/dt
Where L is Inductance
V_c= Q/C

Where Q is charge store in capacitor and C is capacitance of the capacitor.
And Most of all the voltage is defined over different parameter as below:
1 Volts = 1 Ampere * 1 ohm = 1 Henry * 1 Ampere/second = 1 Coulomb/Farad

To ensure individuals won`t be confuse by the name and units, here is a table:

Table 6.3.8. Electrical Units

Symbol	Name	Unit
E	Impressed Voltage	volt
I	Current	ampere
Q	Charge	coulomb
R	Resistance	ohm
L	Inductance	henry
C	Capacitance	farad

And speaking of Voltage drop, according to Kirchoff 's law base in the following statements in the resistor, inductance and Capacitance:

LI` + RI + 1/CQ

This equation have two mystery forms, the I(current) and the Q(charge). This results of the possibility of having this equation into a second order equation in Q by implying that Q` = I

$$LQ'' + RQ' + \frac{1}{C}Q = E(t)$$

In one part of the RLC circuit, if there is any sign of free oscillation if E(t) = 0 for t > 0, we would need to find the current by first set up the characteristic equation of from

$$LQ'' + RQ' + \frac{1}{C}Q = 0$$

Into

Lr^2 + Rr + 1/C = 0

With it we would try to find the find the roots of R1 and R2, thankfully, since the RLC circuit is a spring mass system, the root are identify as complex roots, meaning that we would have a use a quadratic formula:

$$\frac{-R\pm\sqrt{R^2 - 4L(1/C)}}{2L} = (\lambda \pm \omega i) \text{ for R1 and R2}$$

Once we found $\lambda\ AND\ \omega$, we would have to plug into a general equation complex form:

$$Q = e^{\lambda t}[C1cos(wt) + C2sin(wt)]$$

Now to find the C1 and C2, we would first have to use Q(0) = Qo, and Q`(0) = I initials, but first, we would have to derivative the Q to Q` by using the product rule
(fg)' = f'g + fg'
Q` = $\lambda e^{\lambda t}[C1cos(wt) + C2sin(wt)] + e^{\lambda t}[- wC1sin(wt) + wC2cos(wt)]$
With these can use Q(0) = Qo, and Q`(0) = I to find out C1 and C2
Once C1 and C2 is found,
We would plug into Q
And have it derivative to Q` one more time because according to the RLC circuit, since we convert to Q` = I(current) then our Q` would be the answer to I current

As you see, the RLC is dedicated in understanding not just the Voltages, it is also allowed to us to understand the Current. This is the reason that we students will be focusing on the following segment, current.
Source: https://digitalcommons.trinity.edu/cgi/viewcontent.cgi?article=1007&context=mono

Links:

The RLC Circuit Question 2: **(Kunal Surujprasad)**
https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/04/17/kunal-surujprasad-project-2-section-6-3-rlc-circuits/

The RLC Circuit Question 3: **(Javier Garcia and Damian Barthwaite)**
[https://drive.google.com/file/d/1Q4hth1m5j7VuXBRov_MOGdqjVU-fjhnO/view?usp=sharing]

The RLC Circuit Question 4: **(Benjamin Yusufov)**
https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/04/22/benjamin-yusufov-project-2/

The RLC Circuit Question 5: **(Danny Mizhquiri and John Villalona)**
https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/04/17/project-2-section-6-3-rlc-circuit-question-5/

The RLC Circuit Question 6: **(Luijen Payano)**
https://drive.google.com/file/d/1GJazqsiKk80V72J36lUfBnxmS0Og-UaW/view?usp=sharing

The RLC Circuit Question 7: **(Javier Bonilla)**
https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/04/15/project-2-section-6-3-rlc-question-7/

The RLC Circuit Question 8:(**Ebtida Ahmed**)
https://drive.google.com/file/d/1eLswHJfeVtrvce3VDcbkbnHsSE2sEf_H/view?usp=share_link

The RLC Circuit Question 9: **(Ameer Shadick and Kevin Jaisingh)**
https://drive.google.com/file/d/1ob5BFxGqWC1N3hPG60Xjloeldq4JfPi-/view?usp=sharing

The RLC Circuit Question 10: **(Atta Tariq and Maharin Khondoker)**
https://drive.google.com/file/d/1uRuLnfwom1SI08Y3oz2f46EoEmmpO_vy/view?usp=drivesdk

Challenge Yourself:

Find the Current in the RLC circuit, assuming the $E(t) = 0$ for $t > 0$
R = 8 ohm; L = .1 henrys; C = 0.005 farads; Qo = 3 coulombs; Io = 2 amperes