

UM-SJTU JI 2024FA VE215 Lab #5

In this lab, we will evaluate some characteristics of second order circuit.

- Please hand in your post-lab assignment before the due date. Please do your post-lab assignment following the requirements in each problem.

Both hand-written and printed are accepted.

- You are encouraged to print this lab manual and then finish the post-lab questions on it. For pictures or diagrams, you may print it in a paper, cut it down and paste on this worksheet.

- Always attach the pictures or screenshots of your waveforms if using the oscilloscope.

Instruments

Function Generator with coaxial cables

Oscilloscope with coaxial cables

Multi-meter

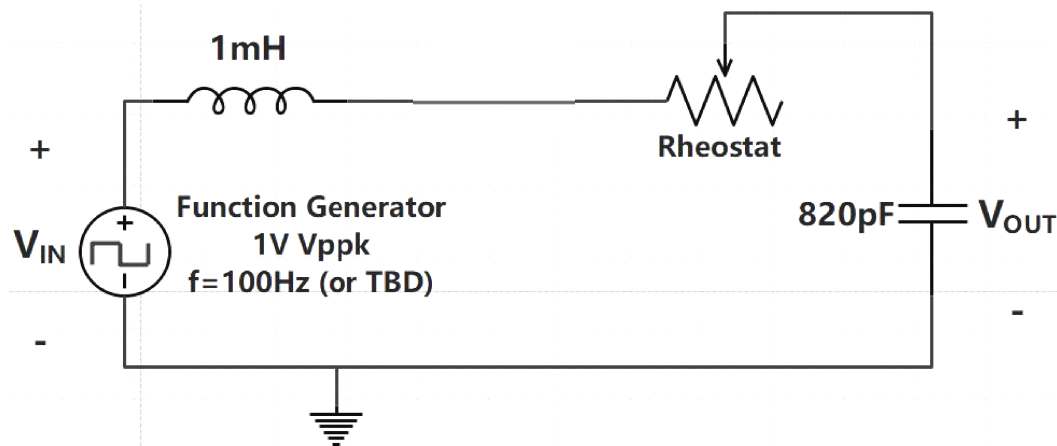
Breadboard and Wires

Capacitor of **820pF**

Inductor of **1mH**

Rheostat **0Ω~10kΩ**

Problem #1 Series-RLC 2nd Order Circuit



Please connect the circuit based on the Schematic above, turn on the function generator and then set a square wave at **1 Vppk** and **100 Hz**.

Caution: Please set the output impedance of function generator to high-Z mode. Besides, please use the oscilloscope to measure the voltages by monitoring the input signal in Channel 1 and the output in Channel 2. You may adjust the frequency of function generator in order to let the capacitor can be fully charged or discharged during the half period of the input wave if necessary.

Then, please adjust the resistance of rheostat to generate the three kinds of response (over-damped, critical damped and under-damped) and then measure the rise time (output voltage) of the first complete rising period, fall time (output voltage) of the first complete falling period, the time interval ΔT (output voltage) between two neighboring peaks (only for the under-damped cases) and the resistance of rheostat corresponding to each cases. Please **screenshot or take photos of your waveforms of three damping cases** and complete the table in the next page during your

measurement.

Damping Cases	Rise time	Fall time	ΔT	Resistance of rheostat
Over-Damped				
Critical-Damped				
Under-Damped				

After that, please set your rheostat to **0Ω** (or short off the rheostat) and observe the waveform of output voltage you obtained. Similarly as before, please measure the rise time (output voltage) of the first complete rising period, fall time (output voltage) of the first complete falling period, the time interval ΔT (output voltage) between two neighboring peaks. Please **screenshot or take photos of your waveform** and complete the table.

Damping Cases	Rise time	Fall time	ΔT	Resistance of rheostat
No Damping				0Ω

Post-Lab Questions for (P1)

(1) Please attach three photos of your waveform (over-damped case, critical damped case and under-damped case) as well as the data table in the post-lab assignment.

Over-damped case:

Critical-damped case

Under-damped case:

No-damping case:

(2) What are the theoretical values of the rise time (output voltage) of the first complete rising period , fall time (output voltage) of the first complete falling period, the time interval ΔT (output voltage) between two neighboring peaks of the under-damped case according to the rheostat resistance you choose? Please compare them with the experimental results and list some possible reasons if they are not the same.

(3) What is the relationship between the under-damped case and zero-damped case? What roles did the rheostat play as?

References

- [1] *Circuits Make Sense*, Alexander Ganago, Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor.