**Class\_\_\_\_\_\_ Student ID\_\_\_\_\_\_\_\_\_\_\_\_\_ Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Instructor\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pre-class Assignment Grade\_\_\_\_\_\_\_\_\_\_\_ Final Grade\_\_\_\_\_\_\_\_\_\_**

**Experiment：Characteristics of RLC Circuits**

**Ⅰ. Pre-Lab Preparation**

1. What are the voltage expression for the transient process of the series RC and RL circuits, and the expression for the time constant τ?
2. What are the voltage expressions for the transient process (three types of damping processes) of the series RLC circuit, and the expression for the time constant τ?
3. Please draw the circuit diagram to observe the series RC, RL, and RLC circuits using a digital oscilloscope and a signal generator.

**II. Original Data**

**1. Transient characteristics of the series RC circuit** (Use square-wave pulses with Vpp=10V)

*R*= 500 Ω

|  |  |  |  |
| --- | --- | --- | --- |
| *τ C* | 0.022μF | 10μF | 100μF |
| Period of square waves (T) |  |  |  |
| Time constant *τ* |  |  |  |
| Waveform |  |  |  |

*C*= 100 μF

|  |  |  |  |
| --- | --- | --- | --- |
| *τ R* | 10Ω | 50Ω | 100Ω |
| Period of square waves (T) |  |  |  |
| Time constant *τ* |  |  |  |

**2. Transient characteristics of the series RL circuit** (Use square-wave pulses with Vpp=10V)

*L*= 10 mH Period of square waves T*=*0.02 s

|  |  |  |  |
| --- | --- | --- | --- |
| *τ R* | 100Ω | 500Ω | 900Ω |
| Voltage on R (*U*R) |  |  |  |
| Time constant *τ* |  |  |  |

*R*= 1000 Ω Period of square waves T=0.02 s

|  |  |  |  |
| --- | --- | --- | --- |
| *τ* *L* | 10 mH | 50 mH | 100mH |
| Voltage on R (*U*R) |  |  |  |
| Time constant *τ* |  |  |  |

**3. Transient characteristics of the series RLC circuit** (Use square-wave pulses with Vpp=10V)

In the underdamped state, measure the first peak value at time *t*1 and the following peak value at time *t*1+*nT* () of the underdamped *U*C charging oscillation waveform during the charging process.

Set *L=* 10mH（*RL*=6.5 Ω）*, R=*0 Ω，*C=*0.022 μF

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *n* | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *U*c(t1+*n*T) |  |  |  |  |  |  |  |  |  |

*E*=\_\_\_\_\_\_\_\_\_\_， *t*1=\_\_\_\_\_\_\_\_\_\_，T=­­\_\_\_\_\_\_\_\_\_\_

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| **教师** | **姓名** |
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**III. Data Processing**

1. Calculate the theoretical time constants for each experiment, compare them with the measured values, and analyze the reasons for the errors.
2. From the measured peak values at time of the underdamped *UC* charging waveform, determine the slope of ～*t* using the least squares method or a graphical method. Calculate the time constant τ from the slope, compare it with the theoretical value （*R*=*R*resistor+ *RS*+ *RL*）, and analyze the reasons for the error.

**IV. Analysis of the experimental phenomena and conclusion**

**V. Questions**

1. In RC and RL circuits, if the square-wave frequency f is fixed while changing the resistance R, why will you get different waveforms? If R is fixed while changing the square-wave frequency f, will you get similar waveforms? Why?

2. In an RLC circuit, why do you need to adjust the square-wave frequency appropriately to observe the damped oscillation waveform? What will happen if the frequency is too high? Try to observe.