

# Basic Elec. Engr. Lab

ECS 204/210

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**Office Hours:**

**BKD 3601-7**

**Tuesday 9:30-10:30**

**Friday 14:00-16:00**

# Lab 4

- AC Circuit
- Time-varying Signal
- Oscilloscope
- Function generator

# Time-varying periodic signal (voltage)

- Suppose the period is  $T$ .

- Instantaneous value at time  $t$ :  $v(t)$  [V]

- Average value

$$\overline{v(t)} = \frac{1}{T} \int_{t_0}^{t_0+T} v(t) dt \quad [V]$$

- RMS value

$$\sqrt{\overline{v^2(t)}} = \sqrt{\frac{1}{T} \int_{t_0}^{t_0+T} v^2(t) dt} \quad [V_{rms}]$$

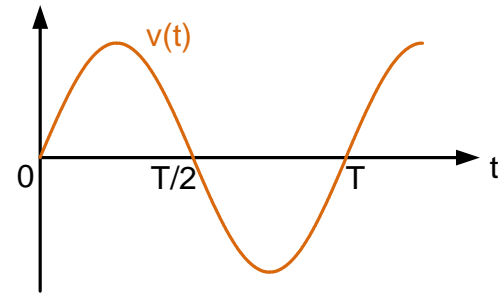
- Peak value

$$\max_{t_0 \leq t \leq t_0+T} v(t) \quad [V_p]$$

- Peak-to-peak value

$$\left( \max_{t_0 \leq t \leq t_0+T} v(t) \right) - \left( \min_{t_0 \leq t \leq t_0+T} v(t) \right) \quad [V_{p-p}]$$

# Sinusoidal signal (voltage)



- The period is  $T = \frac{1}{f} = \frac{2\pi}{\omega}$
- Instantaneous value at time  $t$ :  $v(t) = A \cos(\omega t + \theta)$  [V]

- Average value

$$\overline{v(t)} = \frac{1}{T} \int_{t_0}^{t_0+T} v(t) dt \quad [V] \quad = 0$$

- RMS value

$$\sqrt{\overline{v^2(t)}} = \sqrt{\frac{1}{T} \int_{t_0}^{t_0+T} v^2(t) dt} \quad [V_{rms}] \quad = \frac{A}{\sqrt{2}}$$

- Peak value

$$\max_{t_0 \leq t \leq t_0+T} v(t) \quad [V_p] \quad = A$$

- Peak-to-peak value

$$\left( \max_{t_0 \leq t \leq t_0+T} v(t) \right) - \left( \min_{t_0 \leq t \leq t_0+T} v(t) \right) \quad [V_{p-p}] \quad = 2A$$

# Steady-State AC Analysis

- Phasor Domain:

$$\mathbf{V} = \mathbf{Z}\mathbf{I}$$

Resistor

$$Z = R$$

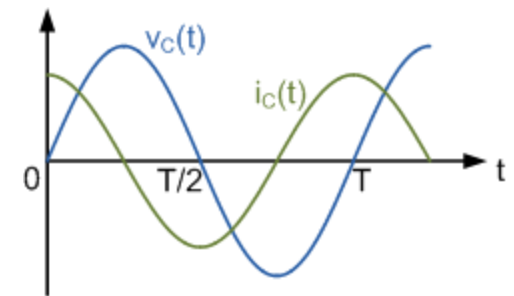
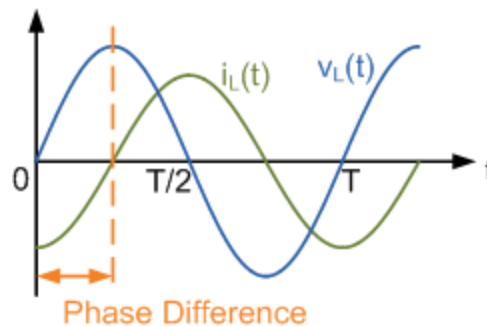
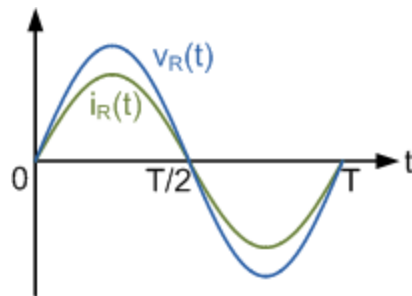
Inductor

$$Z = j\omega L$$

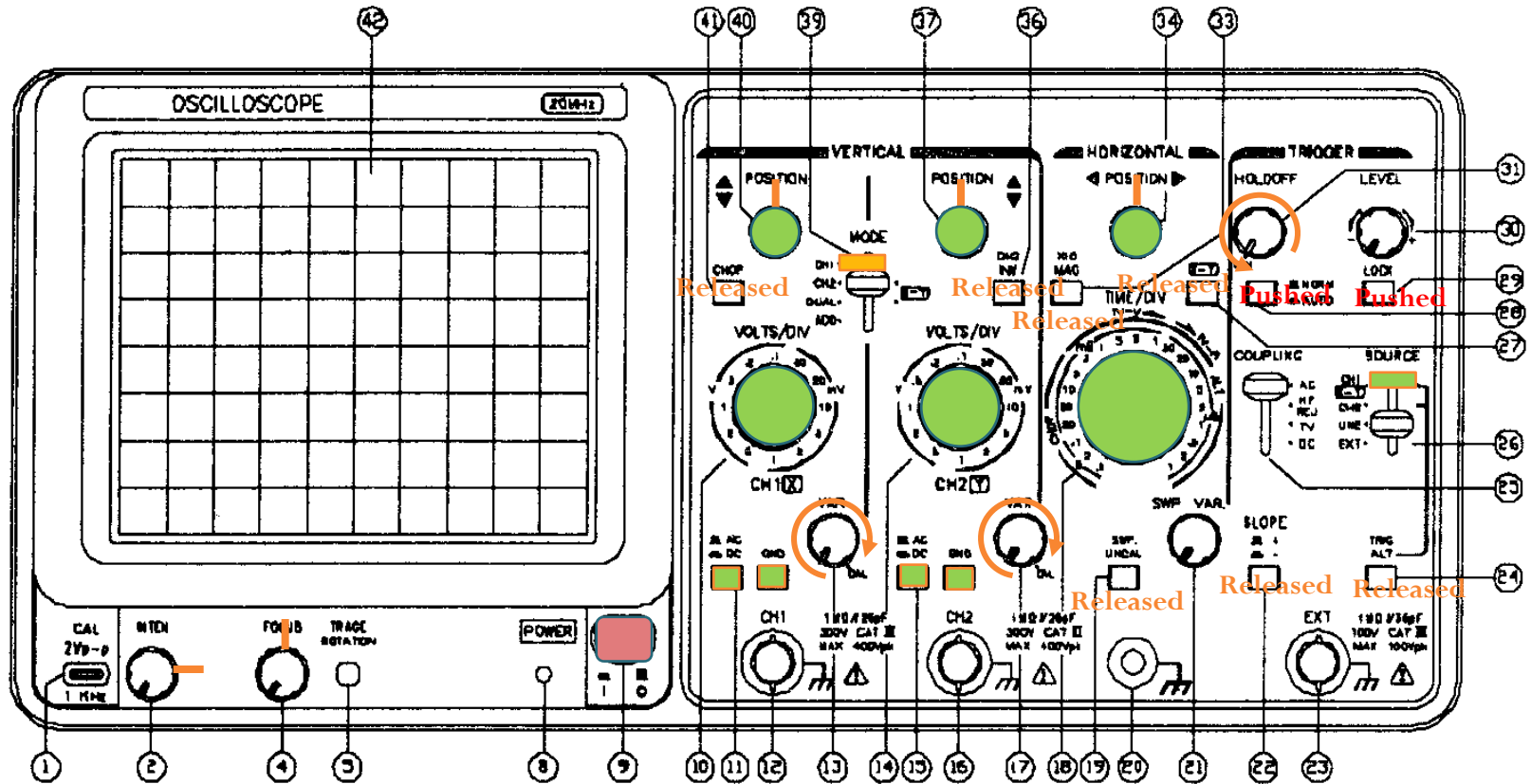
Capacitor

$$Z = \frac{1}{j\omega C}$$

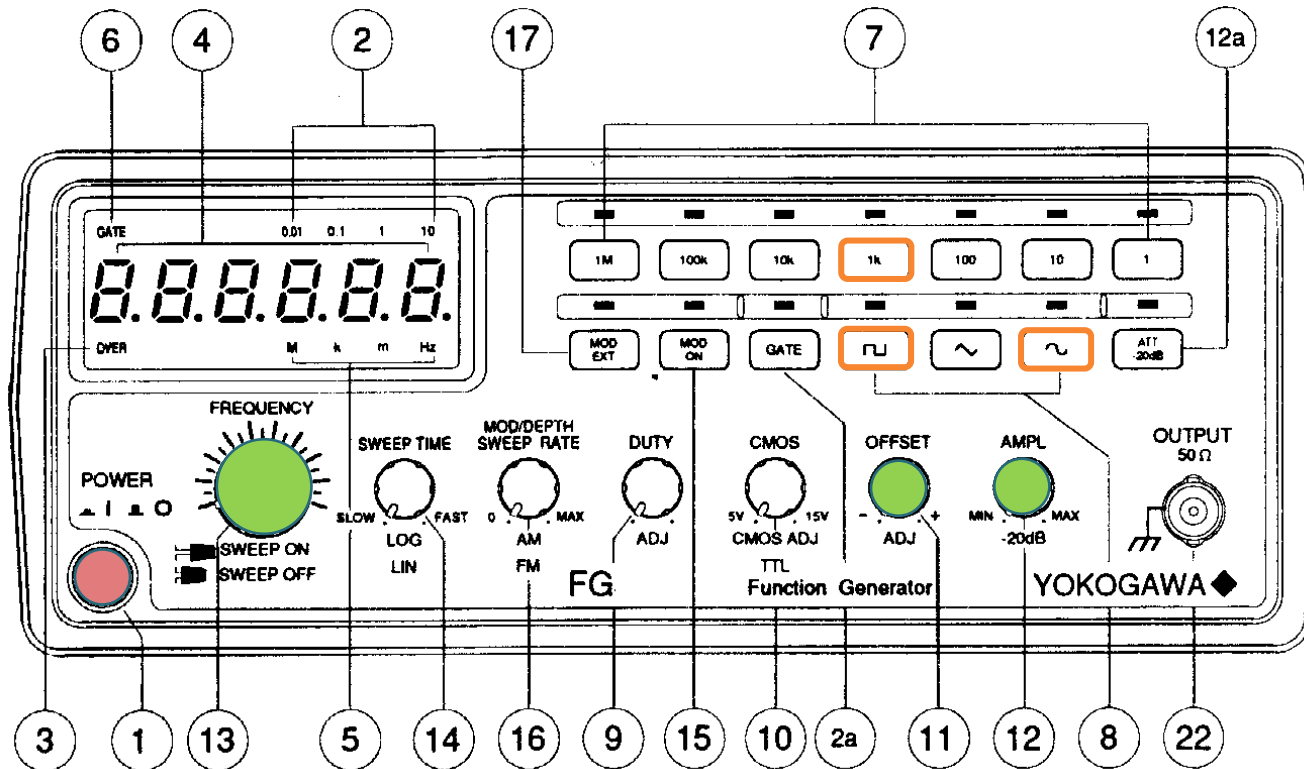
- Time Domain:



# Oscilloscope Preparation



# Function Generator

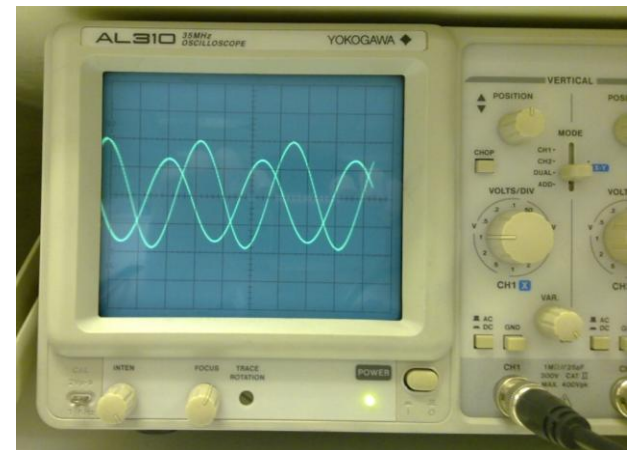
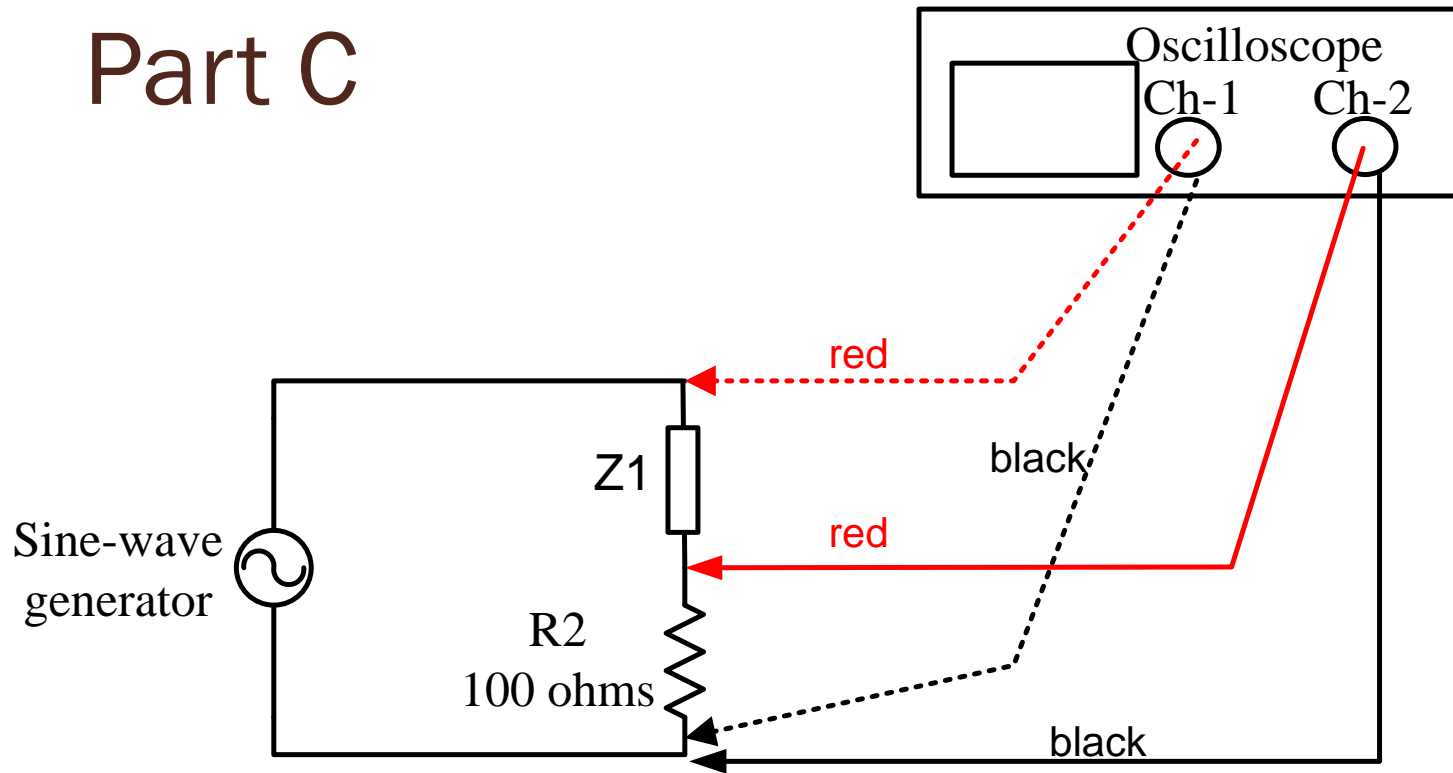


# Demo 1

- 4 V<sub>p-p</sub> Sinusoid



# Part C



# Demo 2

# Midterm Results (20%)

