

University of Wales Trinity Saint David

Wales Institute of Science and Art



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

Electronic circuit testing and applications

Electrical Control Systems (ACHA4010)

Suphakit Pratt

2203284

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1 Task 3

1.1 Scope Time Division Calculations (3)

Frequency (f) of wave= 10hz

Period (P) of a wave $\frac{1}{f} = \frac{1}{10} = 0.1$

Number of divisions(T)=10

$T = \frac{p}{f} = \frac{0.1}{10} = 0.01 \text{ sec}$

1.2 Function Generator output square wave (3)

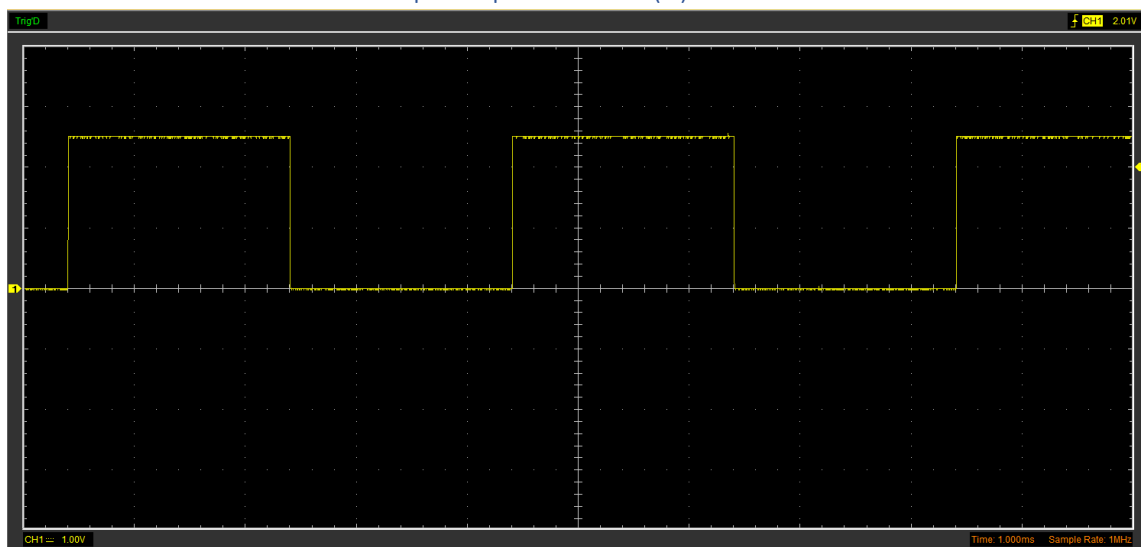


Figure 1 output square wave(made by student)

1.3 Capacitor charge and discharge wave marked at correct points. (3)

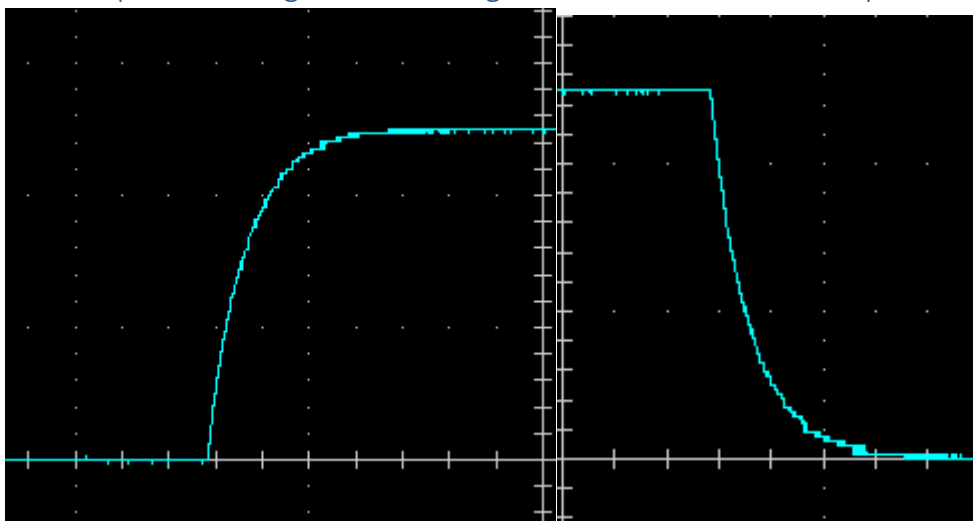


Figure 2 capacitor charging (taken by student)

Figure 3 capacitor discharging (taken by student)

1.4 Basic Capacitor Calculations (3)

$$\text{voltage at time} = \text{intial volatage} \times \text{Euler's number}^{-\text{time} \div (\text{Resistance} \times \text{capacitance})}$$

1.5 Capacitor discharge table (2)

Time (s)	Voltage (V)	ln (V)	dy = y2 – y1 dy = ln(V)2-ln(V)1	dx = x2- x1 dx = Time2 – Time1	dy/dx
0.002079	0.9725	-0.02789	x	x	x
0.002179	2.0392	0.712558	0.74045	0.0001	7404.5
0.002279	2.3529	0.855649	0.143091	0.0001	1430.9
0.002379	2.4784	0.907613	0.05196	0.0001	519.6
0.002479	2.5098	0.920203	0.01259	0.0001	125.9
0.002579	2.5098	0.920203	0	0.0001	0
0.002679	2.5098	0.920203	0	0.0001	0
0.002779	2.5098	0.920203	0	0.0001	0
0.002879	2.5098	0.920203	0	0.0001	0
0.002979	2.5098	0.920203	0	0.0001	0

1.6 Plot log(V) Gradient (2)

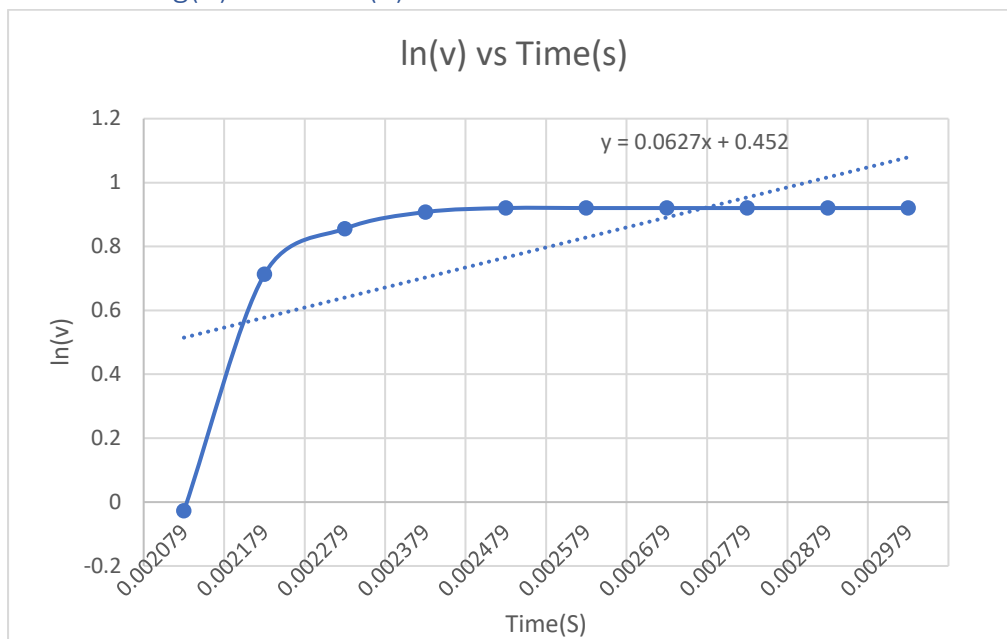


Figure 4 Graph showing $\ln(v)$ vs times (made by student)

1.7 Gradient Calculations and Compare(4)

1.7.1 Gradient Calculations

Slope (y)= 0.0627

$$\text{capacitance (Farads)} = -\frac{1}{\text{resistance(ohms)} \times \text{slope}}$$

1.7.2 Comparison table

	Capacitance	Delta	Percentage difference
Actual	1 μF	x	X
Marker Calculation			
Gradient Calculation			

1.8 Capacitor Uses (5)

Capacitors can be used for:

Storing energy- capacitors are commonly used for energy storage because they can temporarily hold electrical charges, functioning like a short-term battery. In electronic devices and uninterrupted power supplies, they can help maintain power during outages or battery replacements reducing the risk of data loss. For example, in car audio systems, capacitors store energy and releases it when the amplifier is turned on, providing a stable power supply.

Coupling- in capacitive coupling, capacitors are used to link different parts of a circuit by blocking direct current (DC) while allowing alternating current (AC) to pass. This is useful in applications like speakers where DC signals can cause damage. By incorporating capacitors, circuits sections can exchange signals without risk of DC interference.

Power factor corrections- power factor corrections involve using capacitors to improve energy efficiency by adjusting the power factor of a system. Capacitors are switched in and out of the circuit to counteract the effects of the inductive loads from equipment like electric motors and transmission lines. This process reduces energy waste and ensures that only the required amount of power is used.

Power conditioning-capacitors help stabilise energy levels by smoothing out current fluctuations, ensuring a steady and reliable power supply. They serve as a reserve for DC power sources and can bypass AC currents, which helps reduce electrical noise and isolate different sections of a circuit. In audio equipment, for example capacitors are used to divert power line hum, improving sound clarity.

Signal processing- capacitors are important to signal-processing application. In dynamic random access memory (DRAM) devices, capacitors store energy to represent binary data. the device reads the stored value based on whether the capacitors are charged or discharged.

1.8.1 Inaccuracies Question (4)

- **Environmental factors:** Environmental factors like temperature can affect capacitors performance. For example, a high temperature environment could cause capacitors to fail prematurely or give incorrect readings during testing.
- **Signal noise:** Electrical noise from nearby device or unstable power source can interfere with voltage signal, this causes fluctuations in the reading.
- **Discharging capacitors:** If capacitors store charge, it can cause current flow during measurement resulting in inaccurate measurements or damage to the multimeter.
- **Ignoring capacitors polarity:** Some capacitors have polarity (such as electrolytic capacitors). Incorrect polarity connections may lead to inaccurate measurements or damage capacitors.

2 References

(Format to Harvard style as per handbook)

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