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Electronic Circuits Testing and Applications

Electrical Control Systems ACHA4010

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1 Task 1

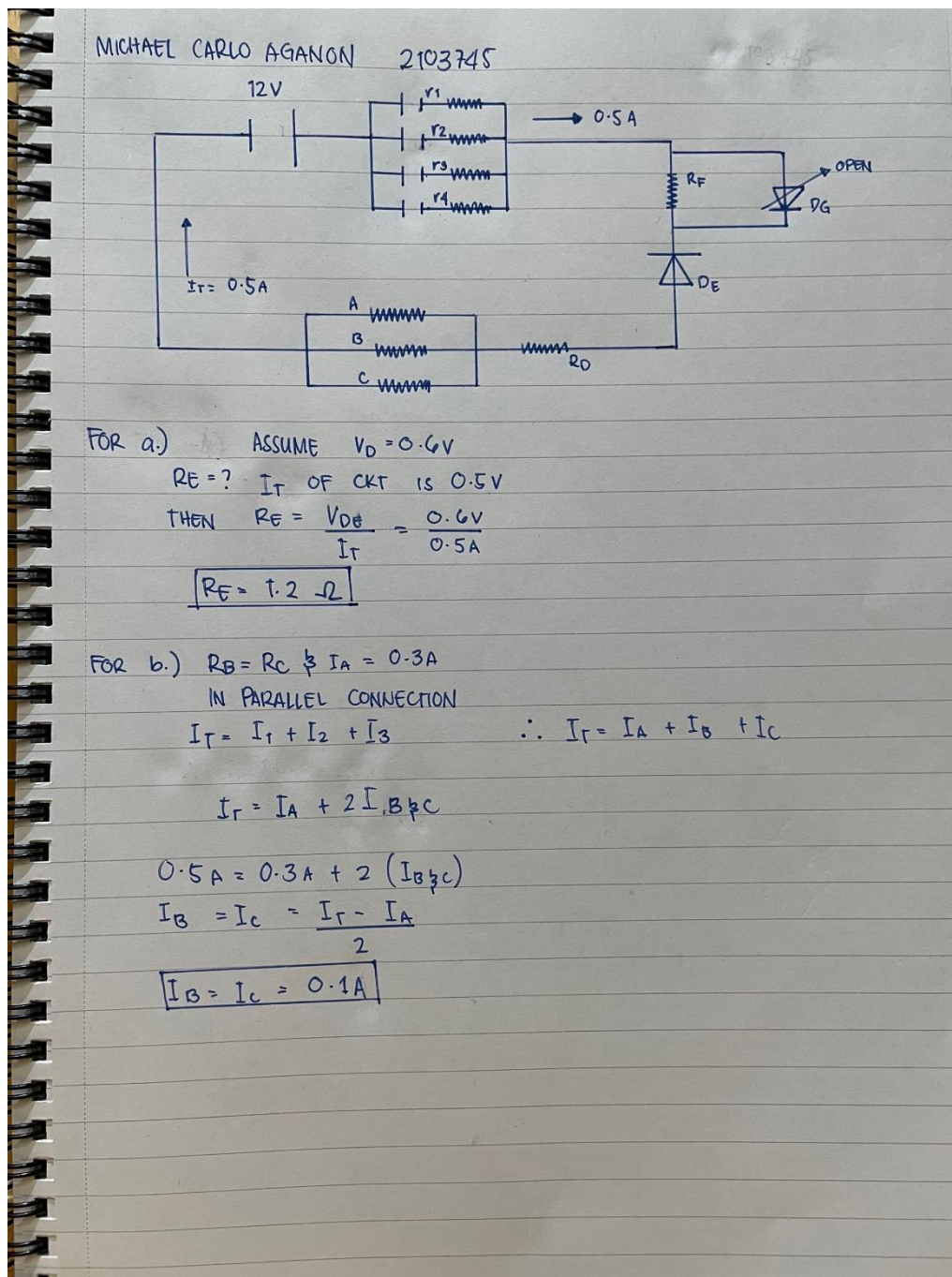


Figure 1. Task 1 Calculation (Aganon, 2023)

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 FOR C.) $0.95 \text{ J/s} = 0.9 \text{ W}$

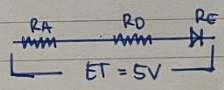
i.) $R_A = ?$ $P = I^2 R$ $P = I_A^2 R_A$
 SINCE $I_A = 0.3 \text{ A}$ & $P = 0.9 \text{ W}$
 $\therefore P = I_A^2 R_A = R_A = \frac{P}{I_A^2} = \frac{0.9}{0.3^2}$ $R_A = 10 \Omega$

II.) R_B & R_C SINCE IDENTICAL ASSUME $R_B = R_C$

$R_B = R_C = ?$ $V_B = V_C = 1 \text{ R}$ FROM 3rd PROBLEM
 $V_B = V_C = 3 \text{ V}$
 $R_B = R_C = \frac{V}{I} = \frac{3 \text{ V}}{0.1 \text{ A}} = 30 \Omega$ $R_B = 30 \Omega$
 $R_C = 30 \Omega$

III.) $V_A, V_B, V_C = ?$

$V_A = I_A (R_A)$ $V_A = (0.3 \text{ A})(10 \Omega)$
 $V_A = 3 \text{ V}$ SINCE R_A, R_B & R_C ARE IN PARALLEL CONNECTION
 WE CAN ASSUME:
 $E_T = E_1 = E_2 = E_3$; $E_T = V_A = V_B = V_C$
 $\therefore V_A = 3 \text{ V}$ $V_B = 3 \text{ V}$ $V_C = 3 \text{ V}$ USE IN 2ND PROBLEM

IV.)  SINCE SERIES
 ASSUME $E_T = V_1 + V_2 + V_3$

THEN $E_T = V_A + V_D + V_{DE}$
 $5 \text{ V} = 3 \text{ V} + V_D + 0.6 \text{ V}$
 $V_D = 1.4 \text{ V}$

$R_D = \frac{V_D}{I_T} = \frac{1.4 \text{ V}}{0.5 \text{ A}}$ $R_D = 2.8 \Omega$

Figure 2. Task 1 Calculation (Aganon, 2023)

2 Task 2

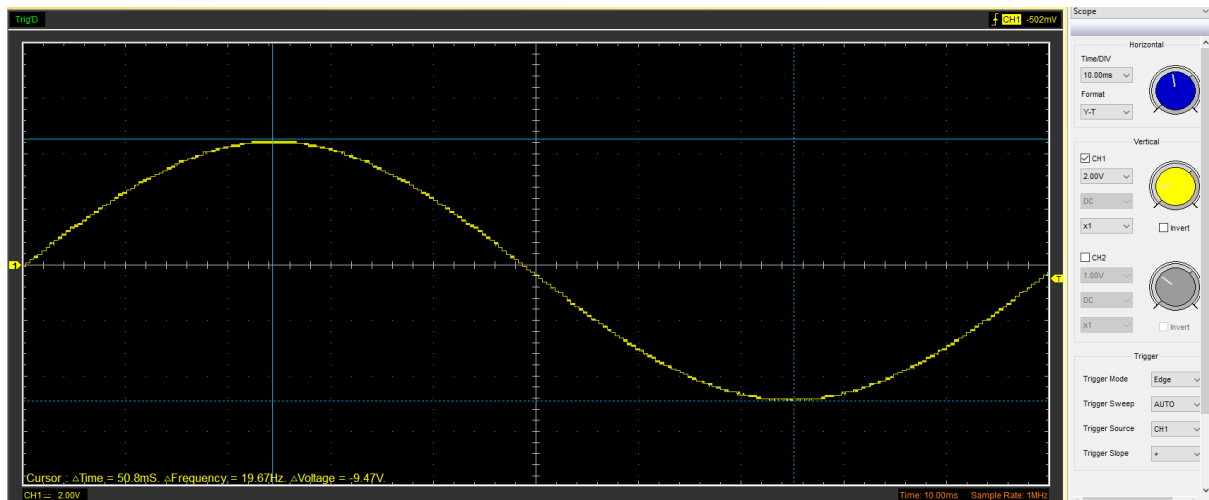


Figure 3. Sinewave

Output	
CH1	
Maximum	4.45V
Minimum	-4.89V
Peak to Peak	9.35V
Top	4.45V
Base	-4.89V
Middle	-220mV
RMS	3.26V
Amplitude	9.35V

Figure 4. The output of Figure 3 (Aganon, 2023)

Question: “Using 10Hz as wave calculate the time division required to see at least 1 full period on the screen.”

$$\text{Wave Period} = \frac{1}{\text{Frequency}}$$

$$\therefore T = \frac{1}{f} \quad T = \frac{1}{10} \quad T = 0.1$$

Question: “The rectifier DC output is lower than the peak of the sinewave input, explain which factors cause this drop.”

Factors such as load resistance, diode voltage drop, and output noise could effectively cause lower DC output. This voltage drop reduces the output voltage of the rectifier and the voltage drop amount depends on the value of the load resistance, the diodes only conduct current in one direction and block the current in opposite direction, which reduces peak voltage and increases ripple voltage of the output which is the AC component present in the rectifier output. Ripple voltage is pulsating DC voltage which means that the output voltage is not a constant DC voltage, the diodes used in the rectifier can cause fluctuations in voltage output that can cause high-frequency noise (Platt, C., 2012)

Question: “Research the common use of rectification on different vehicles and explain their importance.”

An engine’s alternator generates AC power by using a rotating magnetic field to generate electrical current to the stator windings. Cars, motorcycles, trucks, boats, and aircraft all have a common use for rectifiers, as batteries and most electrical components on vehicles operate on DC power, the rectifiers are used to convert the generated AC power into DC power and used to charge the battery and power the electrical components of the vehicle. Without a rectifier, a battery could be discharged and electronic components would not function properly (Denton, T. and Pells, H., 2022)(Emadi, A., 2017)

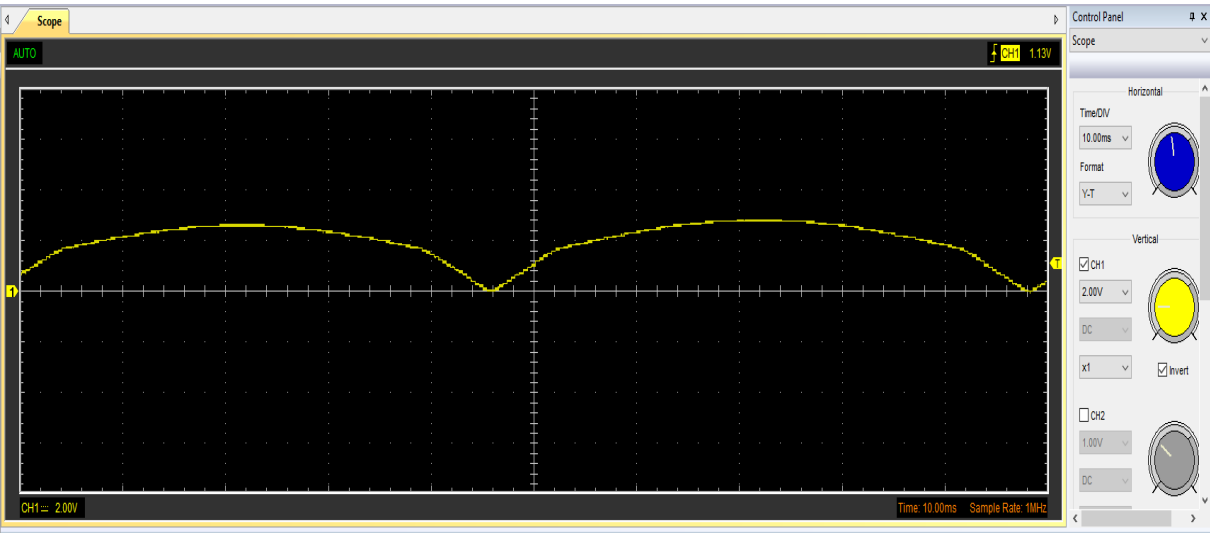


Figure 5. Wave graph without a capacitor (Aganon, 2023)

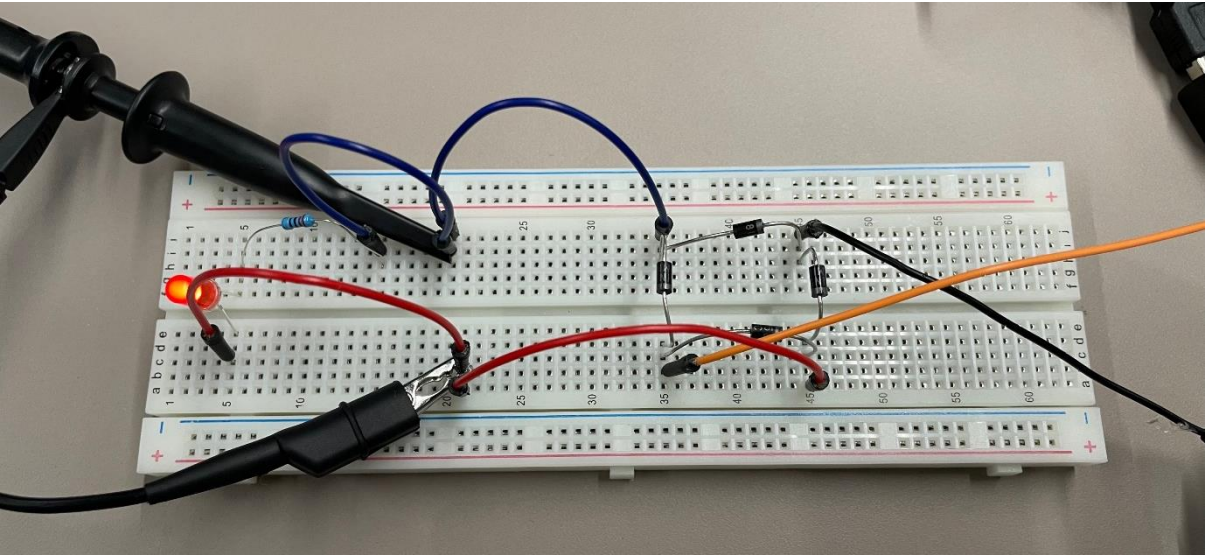


Figure 6. Circuit without a capacitor (Aganon, 2023)

Output	
CH1	
Maximum	2.82V
Minimum	-62.7mV
Peak to Peak	2.89V
Top	2.82V
Base	0.00uV
Middle	1.41V
RMS	2.09V
Amplitude	2.82V
Mean	1.94V
Cycle Mean	1.88V
Positive Overshoot	*****
Negative Overshoot	2.22%
Period	48.0mS
Frequency	20.84Hz
Rise Time	= 17.3mS
Fall Time	= 29.1mS
+ Duty Cycle	76.2%
- Duty Cycle	23.8%
+ Pulse Width	36.6mS
- Pulse Width	11.4mS

Figure 7. The output of Figure 6 (Aganon, 2023)

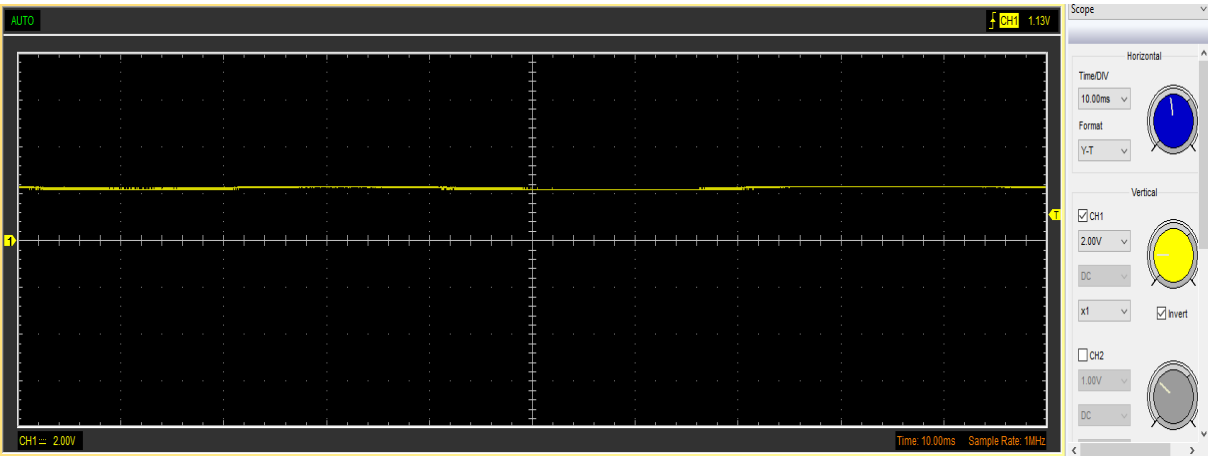


Figure 8. Wave graph with a capacitor (Aganon, 2023)

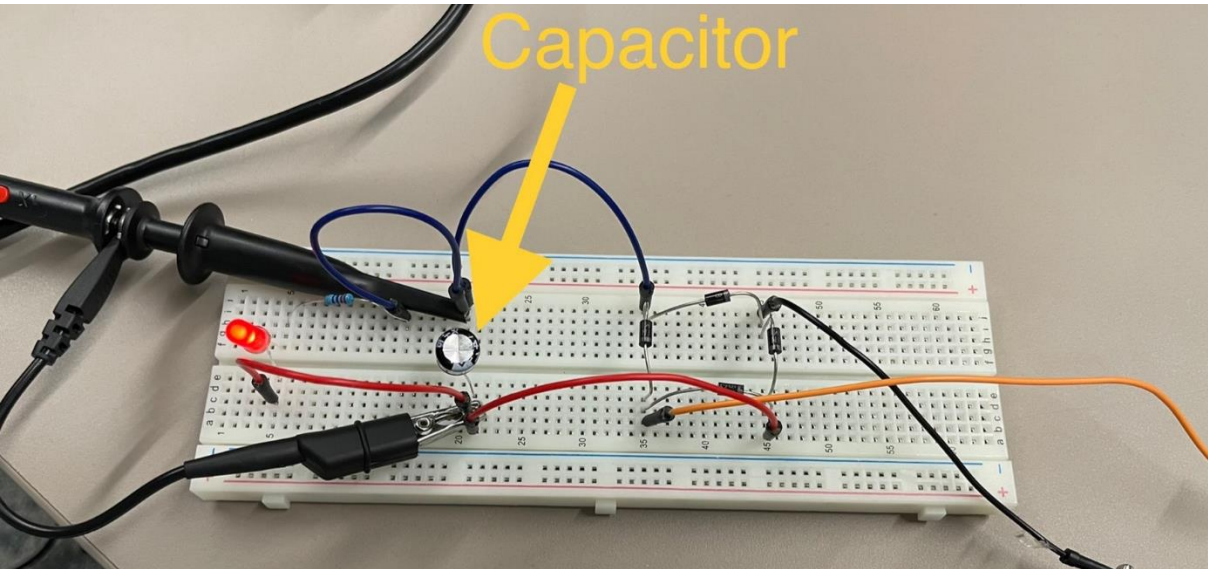


Figure 9. Circuit with a capacitor (Aganon, 2023)

Output	
CH1	
Maximum	2.38V
Minimum	2.20V
Peak to Peak	188mV
Top	2.32V
Base	2.20V
Middle	2.26V
RMS	2.26V
Amplitude	125mV
Mean	2.26V
Cycle Mean	0.00uV
Positive Overshoot	50.00%
Negative Overshoot	*****
Period	*****
Frequency	*****
Rise Time	< 1.00uS
Fall Time	< 1.00uS
+ Duty Cycle	*****
- Duty Cycle	*****
+ Pulse Width	*****
- Pulse Width	*****

Figure 10. The output of Figure 9 (Aganon, 2023)

3 Task 3

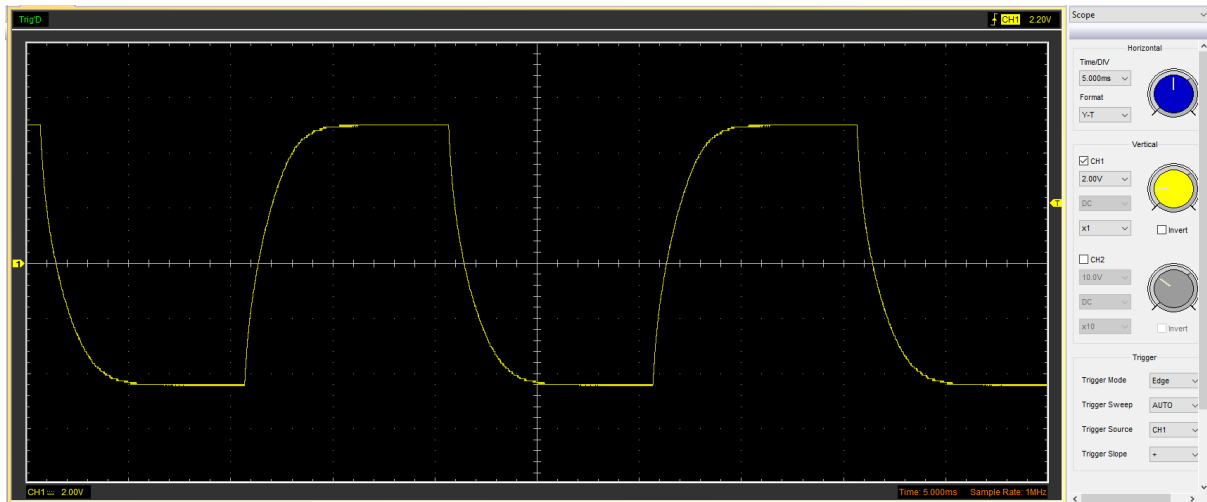


Figure 11. Square Wave

Output	
CH1	
Maximum	5.02V
Minimum	-4.45V
Peak to Peak	9.47V
Top	5.02V
Base	-4.45V
Middle	282mV
RMS	4.19V
Amplitude	9.47V

Figure 12

4 References

Denton, T. and Pells, H., 2022. *Automobile mechanical and electrical systems*. Taylor & Francis.

Emadi, A. ed., 2017. *Handbook of automotive power electronics and motor drives*. CRC press.

Platt, C., 2012. *Encyclopedia of Electronic Components Volume 1: Resistors, Capacitors, Inductors, Switches, Encoders, Relays, Transistors* (Vol. 1). " O'Reilly Media, Inc."