Math 335 Portfolio

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1 Induction Proofs

1.1 Ordinary Induction

According to Kirchoff's Voltage Laws (KVL), we have the following equation:

$$\begin{aligned} &-12 + V_{R_3} + 3V_F = 0 \\ &\Longrightarrow V_{R_3} = 12 - 3V_F \\ &\Longrightarrow R_3 = \frac{V_{R_3}}{I_{sccR_3}} = \frac{V_{R_3}}{I_F} = \frac{12 - 3V_F}{I_F} \end{aligned}$$

• In case of $V_F = 3V \longrightarrow 3.4V$

$$\begin{aligned} &I_F = 25mA - 30mA \\ &\Longrightarrow R_3 \in \left[\frac{12 - 3x3.4}{30x10^{-3}}; \frac{12 - 3x3}{25x10^{-3}}\right] \\ &\Longleftrightarrow \ R_3 \in [60; 120](\Omega) \end{aligned}$$

• Choose $R_1 = 40000\Omega$, we have the following expression:

$$I_{R_2} = I_L = \frac{0.7}{40000} = 1.78x10^6(A)$$

Results below can be extracted by appling kirchoff's Voltage Laws.

$$\begin{aligned} &-12 + V_{R_2} + V_{R_L} = 0 \\ &\Longrightarrow V_{R_2} = 12 - V_{R_L} = 12 - 0.7 = 11.3V \\ &\Longrightarrow R_2 = \frac{V_{R_2}}{I_{R_2}} = 645414(\Omega) \end{aligned}$$

Base on the value of R_L measured by VOM, the following results can be infered:

$$R_2 = \frac{11.3}{\frac{0.7}{R_L}} = \frac{11.3XR_L}{0.7} = 12.14R_L(\Omega)$$

Applying Kirchoff's Laws:

$$\begin{aligned} & I_{R_1} = I_{R_2} + I_{R_3} \\ & \Longrightarrow I_{R_1} = I_{R_2} + I_F \\ & \Longrightarrow I_{R_1} = \frac{0.7}{R_2} + I_F \\ & \Longrightarrow I_{R_1} \in [0.025; 0.03](A) \end{aligned}$$

Measurement results in laboratory reportedly show that voltage at the two ends of the capacitor varies around $12\sqrt{2}(V)$

$$V_{0C} = 12\sqrt{2}(V)$$

• In case of the worst situation when $V_{DC} = 18.8(V)$ R_1 is designed in ways such that $V_{DC} = 12(V)$

$$\begin{aligned} & \Longrightarrow R_1 = \frac{18.8 - 12}{I_{R_1}} \\ & \Longrightarrow R_1 \in [227; 275] \end{aligned}$$

Power: Power Index ≥ 1.5 In case of V_{DC} exceeds the common voltage of $12V$, the circuit can withstand up to $18V$ before suffering structural damages.

$$\begin{aligned} & \Longrightarrow V_{DC} without R_1 = 18\sqrt{2} \\ & \Longrightarrow P_{R_1} = \frac{(18\sqrt{2} - R_1)^2}{R_1} \\ & \Longrightarrow R_1 \in [227; 211] \end{aligned}$$

Procedure:
1. Components list
- Zener Diode
- 100Ω Resistor
- 470000Ω Resistor
- 3 LEDs
- C1815 NPN Transistor
- Light Sensoring Resistor
- 4 Diodes
2. R_1, R_2, R_3 Build Method
$R_3 = R = 100(\Omega)$.