Experiment Eight
Fundamentals of Electromagnetics Lab
EECE2530/1

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Abstract

The goal of this laboratory experiment was to verify the accuracy of Malus' Law through implementations of linear polarizers of varying length in tandem with a power meter. We begin by performing theoretical calculations using Malus' law, and then test these values against experimental values obtained using quarter-wave and half-wave polarizers.

KEYWORDS: Malus' Law, linear polarizer, power meter, quarter-wave, half-wave

1 Equipment

Available equipment included:

- 2 Polarizers:
  - 1 Half-wave Plate
  - 1 Quarter-wave Plate
- Power meter
- Samples to measure optical properties:
  - Transparent acrylic (plexiglass) plate
  - Microscope slide glass
  - Plastic plate with printed characters

2 Introduction & Objectives

We begin by performing calculations using Malus' Law to create a table of theoretical values. We find the theoretical relative intensity (I/I_o) using certain angle values. This generates the following plot:

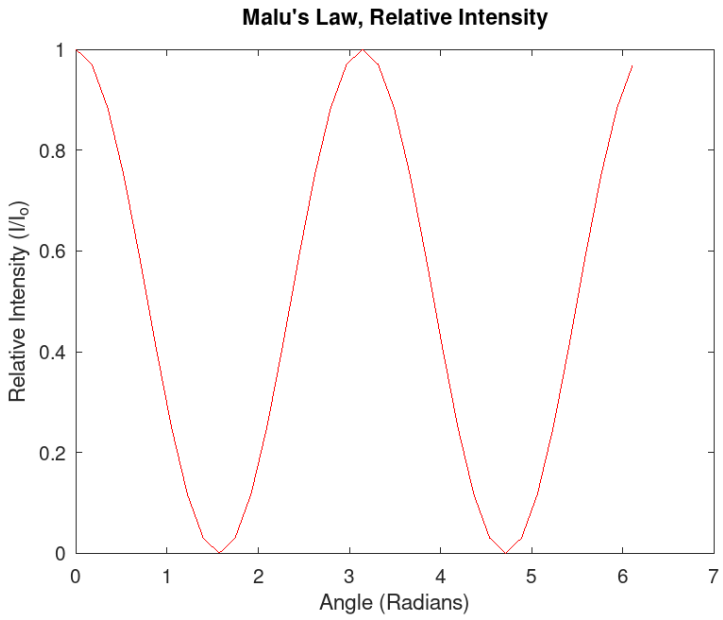

Figure 1: Theoretical Intensity Values

After this, experimental values were obtained using both quarter-wave and half-wave polarizers.

3 Results & Analysis

The experimental values obtained for the half-wave polarizer may be tabulated as follows:

$\theta[^\circ]$	Relative I
0	.05531
10	.009469
20	.016991
30	.079735
40	.17699
50	.32035
60	.47257
70	.62301
80	.73982
90	.82035
100	.85044
110	.83451

$\theta[^\circ]$	Relative I
120	.76637
130	.66991
140	.53894
150	.38496
160	.25044
170	.1292
180	.037434
190	.0061947
200	.031858
210	.10088
220	.21239
230	.36018

$\theta[^\circ]$	Relative I
240	.52124
250	.65133
260	.76372
270	.83982
280	.85221
290	.83274
300	.77788
310	.68407
320	.53894
330	.39381
340	.24336
350	.12478

These values then allowed us to generate the following plot:

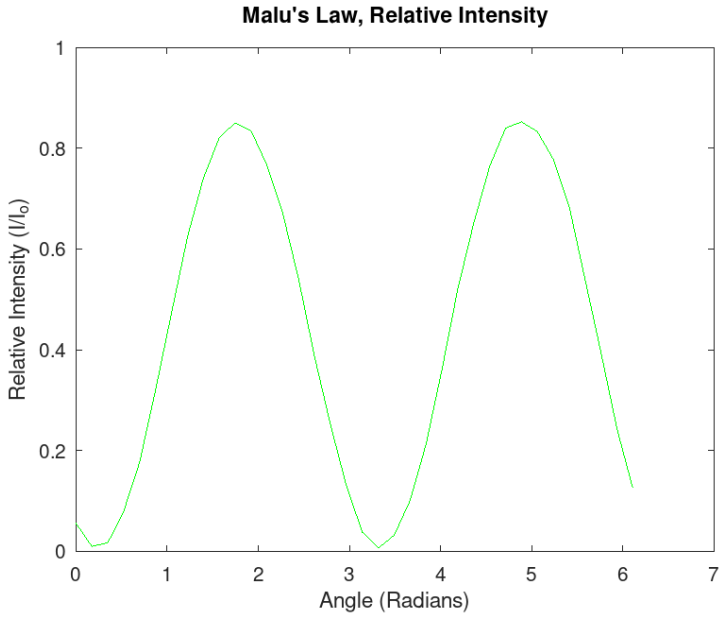

Figure 2: Half-Wave Plate, Experimental Values

The experiment was then repeated for a quarter-wave. For this, the values may be tabulated as follows:

These values then allowed us to generate the following plot:

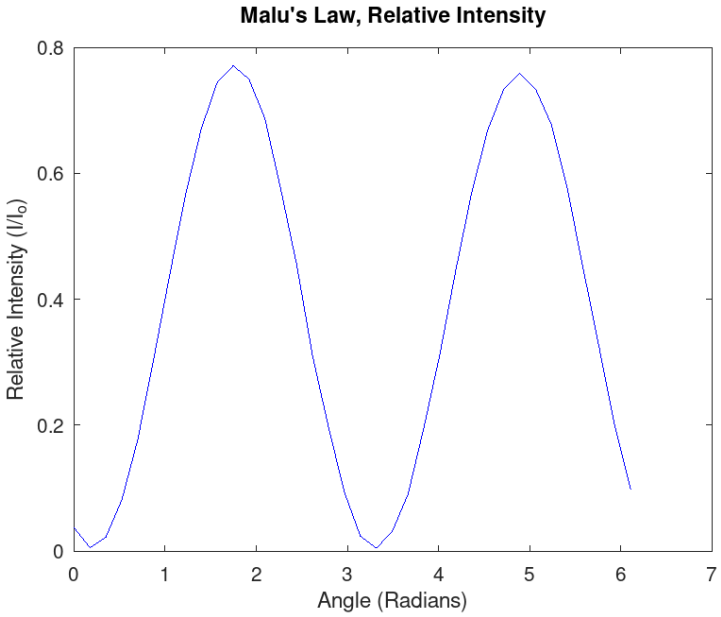

Figure 3: Quarter-Wave Plate, Experimental Values

4 Conclusion

Overall, we can see that, experimentally, our results are quite similar to the theoretical expectations laid out by Malus' Law. The only (minor) difference is a phase shift; however, this is not a significant difference, as the sinusoidal pattern is key. As such, we conclude the accuracy of Malus' Law in various materials.