

EE 236: Experiment 3

Photodiode Characteristics and Applications

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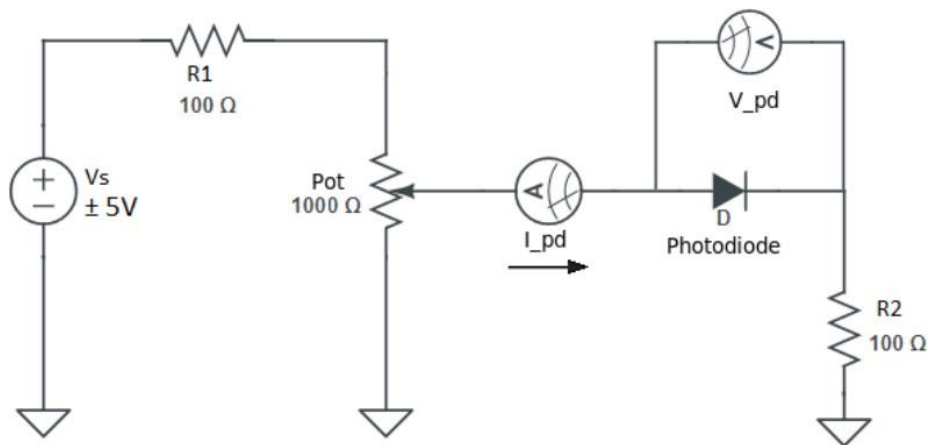
1 Aim

- To study the forward and reverse bias I/V characteristics of a Photodiode.
- To measure the response of the Photodiode for different lights and different intensities. (4 LEDs are provided, along with their current vs intensity data)
- To use the Photodiode as an optical signal sensor in combination with an Infra-red LED.

2 Parts of the Experiment

2.1 Part 1

2.1.1 Circuit

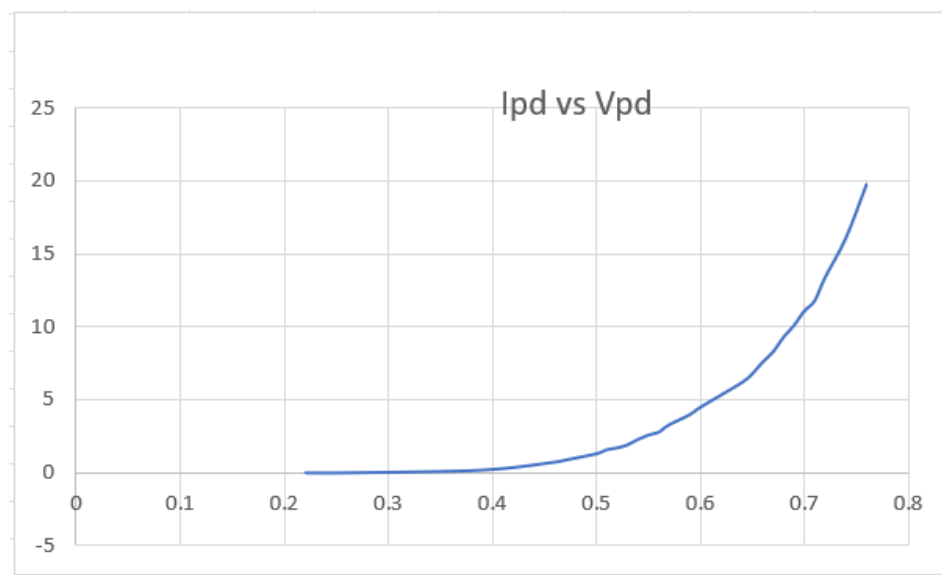


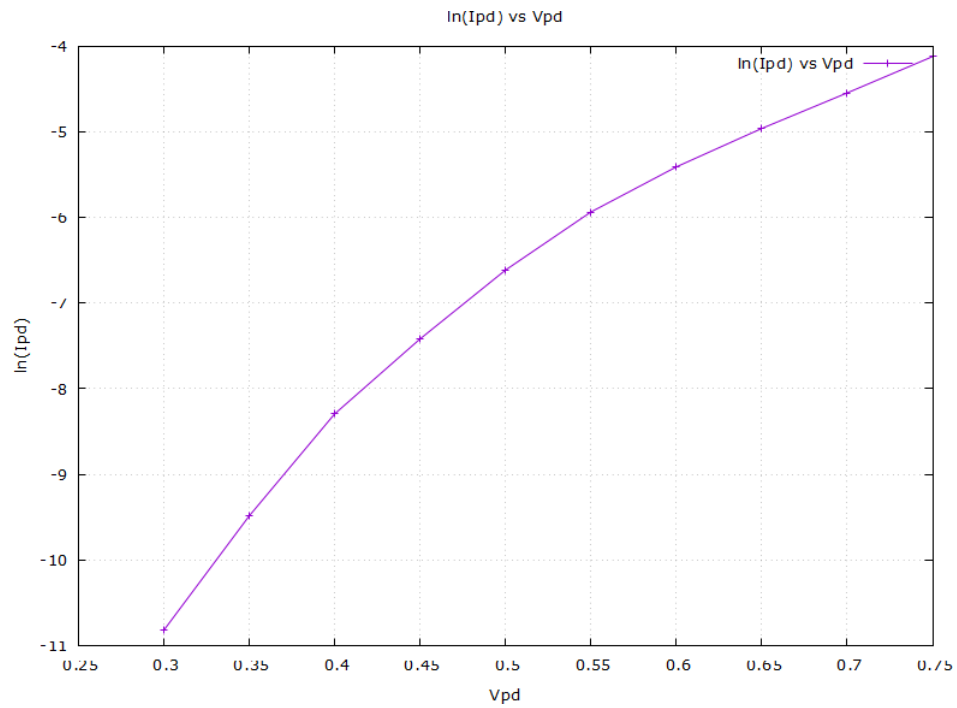
2.1.2 I-V data

V	Ip _d (mA)	log(Ip _d)	Slope	Intercept
0.22	0.00084	-3.07572	8.915544	-4.4535
0.27	0.017	-1.76955	Eeta	
0.39	0.196	-0.70774	4.313987	
0.46	0.742	-0.1296		
0.47	0.881	-0.05502		
0.5	1.317	0.119586		
0.51	1.594	0.202488		
0.52	1.718	0.235023		
0.53	1.93	0.285557		
0.54	2.3	0.361728		
0.55	2.6	0.414973		
0.56	2.8	0.447158		
0.57	3.3	0.518514		
0.59	4	0.60206		
0.6	4.5	0.653213		
0.64	6.2	0.792392		
0.65	6.8	0.832509		
0.66	7.6	0.880814		
0.67	8.3	0.919078		
0.68	9.3	0.968483		
0.69	10.1	1.004321		
0.7	11.1	1.045323		
0.71	11.8	1.071882		
0.72	13.4	1.127105		
0.74	16.1	1.206826		
0.76	19.8	1.296665		

- Ideality factor : 4.313

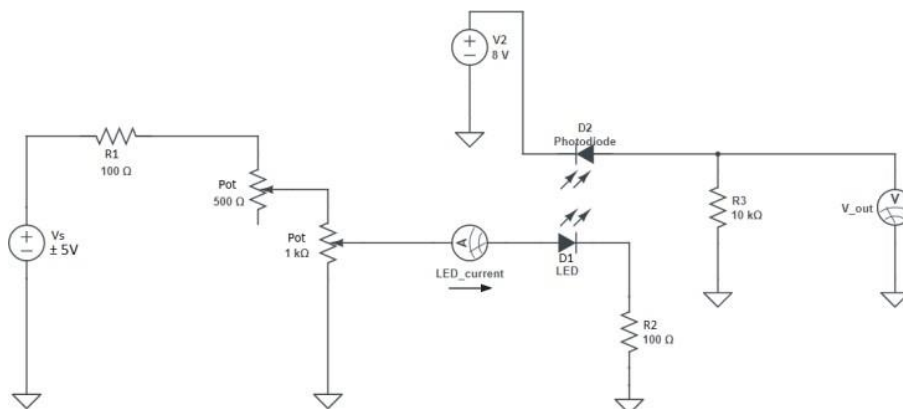
2.1.3 Plots





2.2 Part 2

2.2.1 Circuit



2.2.2 Data

green			
I	Vo(green)	Intensity	Eeta
0.188	0.3	1000	1.595745
0.294	0.4	1500	1.360544
0.371	0.4	2000	1.078167

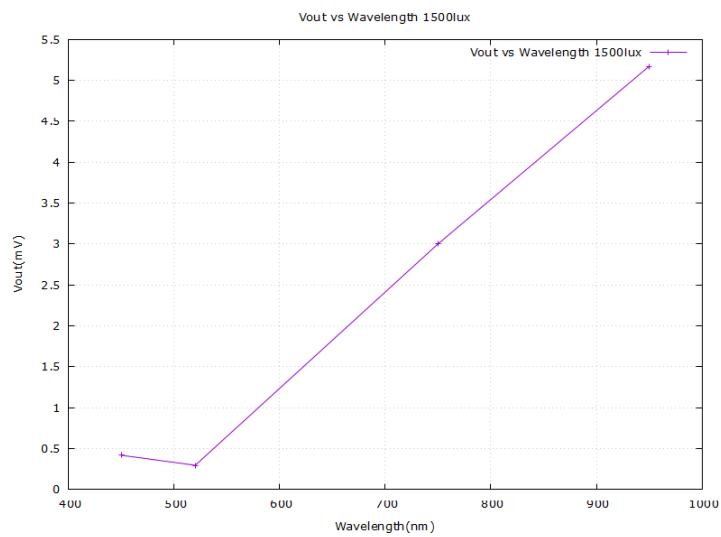
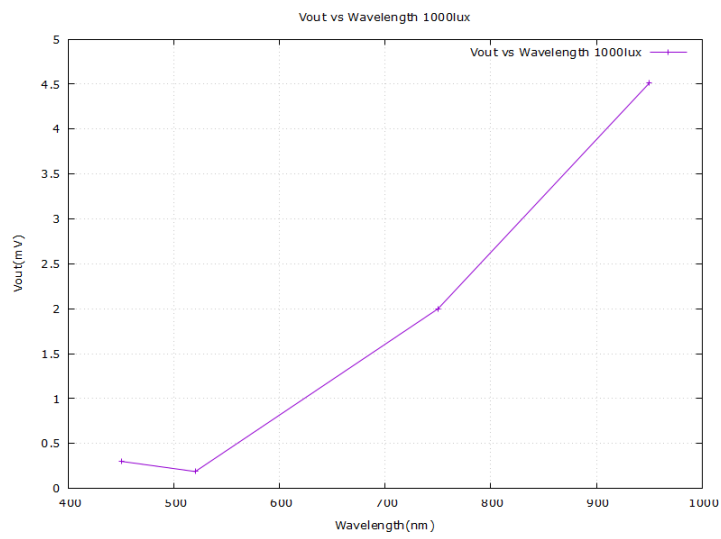
red			
I	Vo(red)	Intensity	Eeta
2	0.6	1000	0.3
3	0.8	1500	0.266667
4	1	2000	0.25

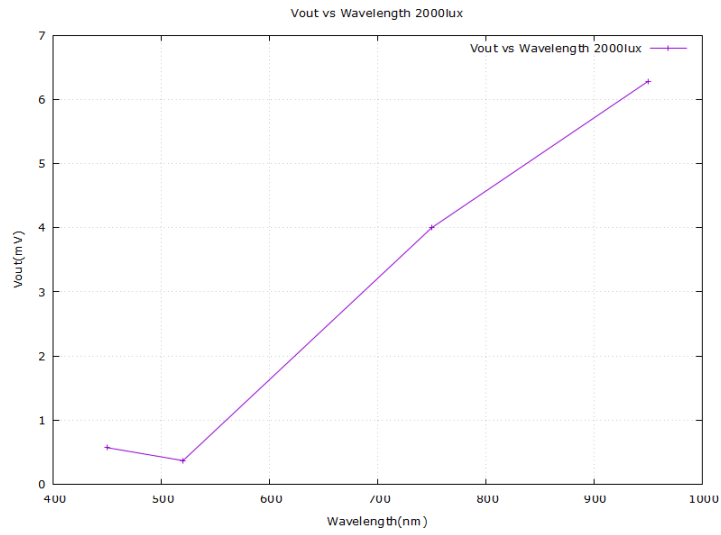
blue			
I	Vo(blue)	Intensity	Eeta
0.301	0.5	1000	1.66113
0.416	0.5	1500	1.201923
0.572	0.6	2000	1.048951

Infrared			
I	Vo(IR)	Intensity	Eeta
4.51	0.9	1000	0.199557
5.17	1	1500	0.193424
6.28	1.1	2000	0.175159

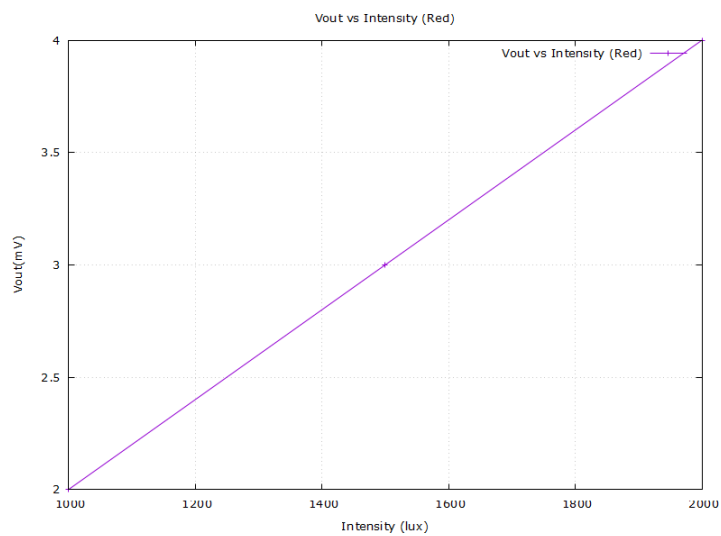
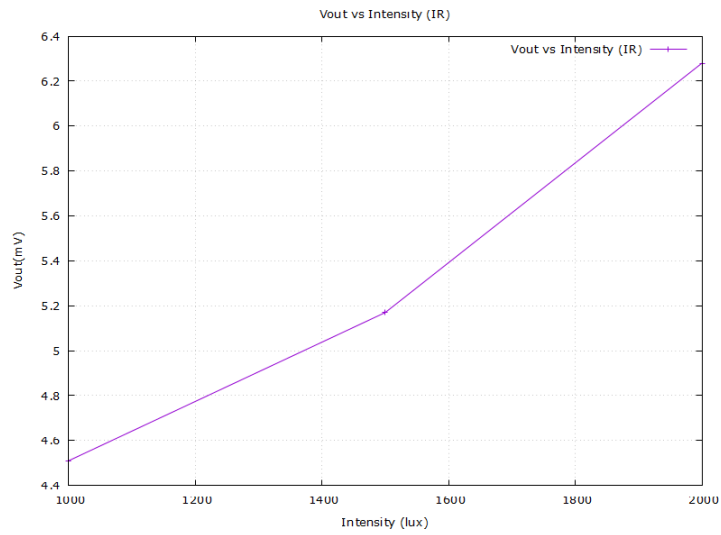
2.2.3 Plots

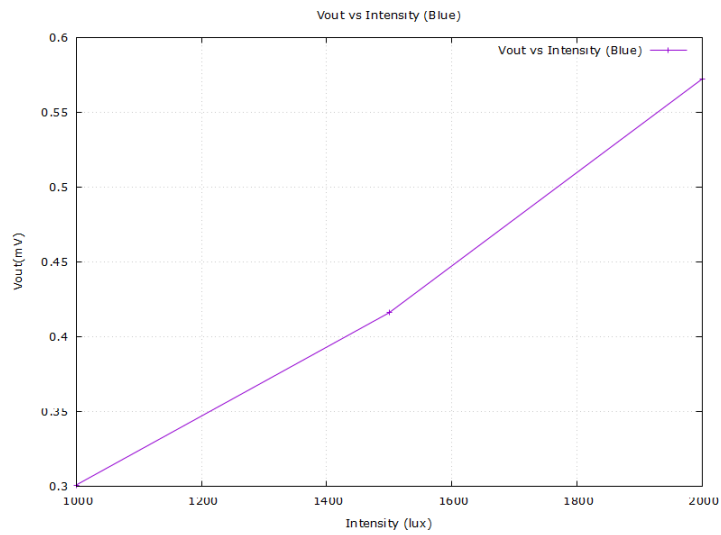
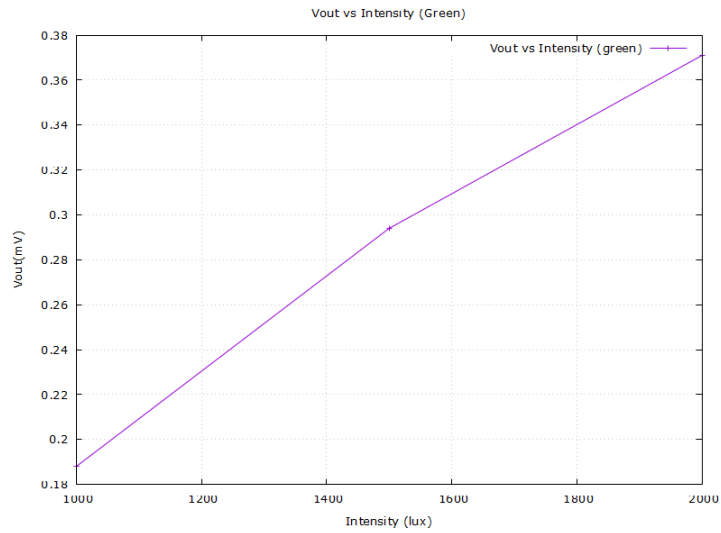
2.2.4 Vout vs Wavelength





2.2.5 Vout vs Intensity

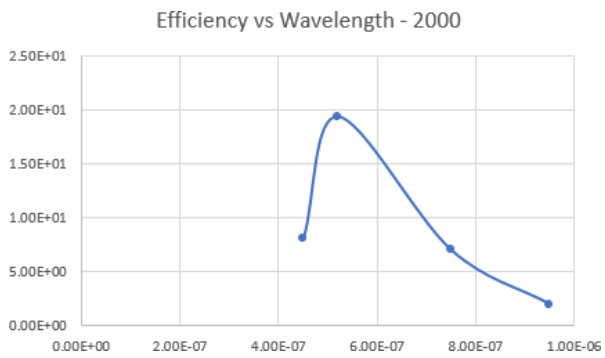
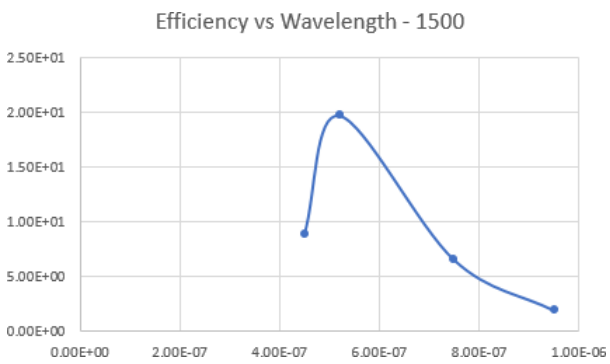
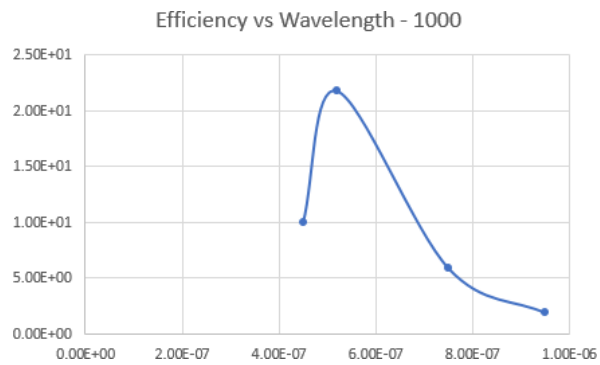




2.2.6 Efficiency

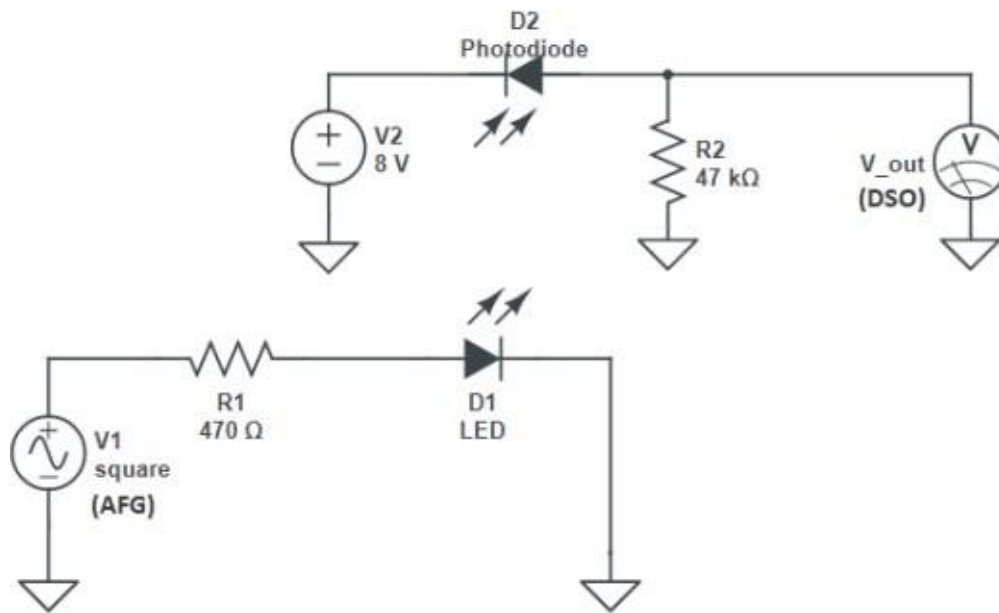
Intensity	IR/Intensity	Red/Intensity	Green/Intensity	Blue/Intensity
1000	1.91E-03	5.90E-03	2.18E-02	9.97E-03
1500	1.27E-03	4.35E-03	1.31E-02	5.93E-03
2000	9.85E-04	3.50E-03	9.70E-03	4.02E-03
Lambda	9.50E-07	7.50E-07	5.20E-07	4.50E-07

Most efficient: Green



2.3 Part 3

2.3.1 Circuit



2.3.2 Data

Frequency (Hz)	Rise time (us)	Fall time (us)
1000	15.37	15.72
5000	11.37	11.62
10000	11.98	11.34
15000	12.31	12.15
20000	12.19	12.03

2.3.3 Observations and Reasoning

- **Distortion:** Distortion is observed to become too large at 20 kHz.
- **Reason for Slow Photodiode Response:** A photodiode has a "detection bandwidth" associated with it, which determines the speed at which its output can vary in response to a varying input signal. This bandwidth depends on two factors:
 1. Junction capacitance in the diode.
 2. Transit time of the photocurrent in the junction.

3 Completion Status

The experiment was thoroughly conducted and successfully completed within the lab setting. All objectives were met, and the procedures were carried out as planned, yielding the expected results.