Photometric Law of Distance

1 Objective

- The luminous intensity I emitted by a punctual source is determined as a function of distance from the source.
- The photometric law of distance is verified by plotting illuminance as a function of the reciprocal value of the square of the distance.

2 Prelab Questions

1. What is the difference between radiometry and photometry?
2. What is a *solid angle*? State the solid angle of a sphere.
3. State the Photometric Law of Distance and explain it.
4. Define the following terms: luminous flux, luminous intensity, illuminance, luminance and luminous existance, stating their respective laws and SI units.

3 Principles

The luminous intensity emitted by a punctual source is determined as a function of distance.

4 Apparatus

- Luxmeter.
- Luxmeter probe.
- Optical profile bench.
- Several slide mounts.
- Filament lamp 6 V/5 A.
- Universal clamp.
- Power supply.

5 Precautions

1. The input voltage for the lamp is 6 V.
2. The luxmeter must be calibrated before actually carrying out measurements. Possible background luminance must be determined with the lamp switched off and must be taken into account during evaluation.
3. Notice that the luxmeter probe is offset from the centre of the clamp.

6 Experimental Steps

1. Switch on the luxmeter and measure the background illuminance E_0.
2. Set the separation r between the probe and lamp to 55 cm.
3. Switch on the lamp and measure the illuminance E.
4. Decreasing the separation in steps of 5cm, record E until you reach a separation of r = 25 cm.

7 Evaluation

1. Calculate r^2 and $\frac{1}{r^2}$.
2. Plot E vs. r^2, confirming the Photometric Law of Distance.
3. Plot E vs. $\frac{1}{r^2}$ and find the slope.
4. Using the slope, calculate the luminous intensity I of the lamp, knowing that:

$$E = \frac{I}{r^2} \tag{1}$$

8 Postlab Questions

1. What is the difference between photopic and scotopic vision?
2. A surface oriented perpendicularly is positioned 2 m away from a lightbulb emitting 100 W of radiant flux.
   (a) Calculate the irradiance E_e at the surface.
   (b) If all 100 W is emitted from a red bulb at $\lambda = 650$ nm, calculate the illuminance E_v at the surface.

   Hint: use the following equation: $photometricunit = K(\lambda) \times radiometricunit$. Where $K(\lambda)$ is the luminous efficacy given by: $K(\lambda) = 685V(\lambda)$ and $V(\lambda)$ is the luminous efficiency obtained from a CIE luminous efficiency curve.