Course of Optical Communications – Telecommunication Engineering

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Practice Work n°1 – 27/04/2006

Last Name:_____ **First Name:** _____

PROBLEMS

1.1 Which form of electromagnetic radiation has a higher frequency than visible light: infrared or ultraviolet?

1.2 a) What is the frequency of a light wave emitted by a sodium arc lamp in a street light with a wavelength of 589 nm?

b) What if the wavelength of the wave is 600 nm?

1.3 If a photon P1 in vacuum has a wavelength twice as long as the wavelength of photon P2, how are their energies related? (Give your answer in the form of a ratio of the energies, E_{P1}/E_{P2}).

1.4 a) A microwave oven emits electromagnetic waves whose wavelengths are about 10 cm. What is the energy of a single photon in the oven?

b) What is the energy if the oven emits at a wavelength of 16 cm?

1.5 What is the energy of a red light photon? And of a blue light photon?

1.6 a) What is the color of monochromatic light with a wavelength of 600 nm?

b) What is the wavelength if you see the blue color?

1.7 What is the basic difference between radiant flux and luminous flux? Which is the more relevant quantity for telling us what we can see?

1.8 Suppose you had a lamp that emitted light at 3 wavelengths (such as some new fluorescent lamp): 2 W at 450 nm, 1 W at 550 nm and 3 W at 650 nm, the human eye sensitivity at the three wavelengths being 26 lm/W, 680 lm/W, and 73 lm/W, respectively. At which wavelength is there the greatest radiant flux? At which wavelength is there the greatest luminous flux? What is the total luminous flux? (Reply to the questions by filling in the table below)

λ (nm)	Radiant flux (W)	Eye sensitivity (lm/W)	Luminous flux (lm)
450			
550			
650			
		Total luminous flux (lm)	

1.9 A small incandescent lamp (assumed to be a point source) provides an illuminance of 300 lm/m^2 on a desktop 1 m away. What would the illuminance be if the light source were mounted on the ceiling 3 m above the desk?

1.10 How is the illuminance of a room affected if a yellow bulb in a lamp rated at 1700 lumens is replaced by a bulb with same luminous flux but of a red color?

1.11 Consider the optical communication system represented in Figure 1.

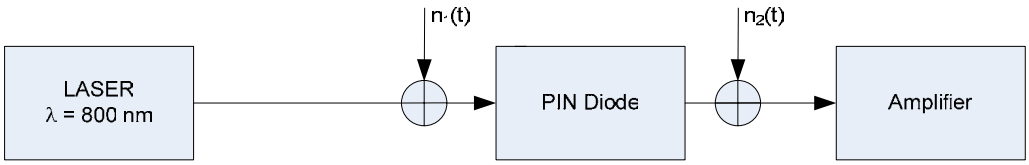

Figure P1.1 – Optical communication system

Let us assume that the emitter is a laser, emitting at a wavelength λ = 800 nm, while the receiver is composed of a silicon PIN diode, followed by a preamplifier characterized by an input impedance $R_i = 10^9$ Ohm and a 3 dB bandwidth B_{3dB} = 200 MHz. As shown in Figure 1, two thermal noise sources are present: $n_1(t)$, at the input of the PIN diode, and $n_2(t)$, at the input of the preamplifier. Determine the value of the spectral densities $P_{n1}(f)$ and $P_{n2}(f)$ of $n_1(t)$ and $n_2(t)$, respectively, in the frequency range of interest, using the general formula for the thermal noise spectral density, that writes:

$$P_n(f) = \frac{h \cdot f}{e^{h \cdot f / k \cdot T} - 1} \quad where \quad \begin{cases} h = 6.62 \cdot 10^{-34}\ J \cdot s \\ k = 1.38 \cdot 10^{-23}\ J / K \end{cases} \tag{P1.1}$$