Experiment no. 5

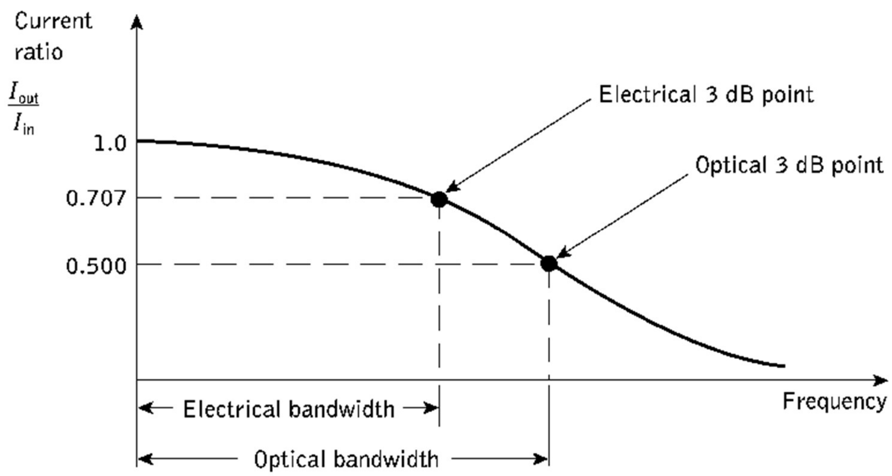
Aim: To study relationship between optical and electrical bandwidth

Lab Outcome: Plot frequency response of optical sources and receivers and find relationship between optical and electrical bandwidth.

Software: Scilab

Theory:

a) **Concept of optical and electrical bandwidth:** The modulation bandwidth in optical communications may be defined in either electrical or optical terms.



The electrical 3 dB points occur when the ratio of electric powers is 1/2. Hence it follows that this must occur when:

$$\left(\frac{I_{OUT}}{I_{IN}}\right)^2 = \frac{1}{2} ==> \left(\frac{I_{OUT}}{I_{IN}}\right) = \frac{1}{\sqrt{2}}$$

Optical 3dB point occurs when the ratio of the powers is ½ and since optical power is directly proportional to current, we can say that optical 3dB point occurs when current ratio is 1/2 :

$$\left(\frac{I_{OUT}}{I_{IN}}\right) = \frac{1}{2}$$

Optical power at particular frequency 'w' can be calculated as:

$$\frac{P_e(\omega)}{P_{dc}} = \frac{1}{[1 + (\omega\tau_i)^2]^{\frac{1}{2}}}$$

where τ_i s the injected carrier lifetime in the recombination region.

Problem statement:

Write a program to plot ratio of output power to the input power vs frequency for different carrier recombination life time.

The minority carrier recombination lifetime for an LED is 5 ns. When a constant d.c. drive current is applied to the device the optical output power is 300μW.

1. Determine the optical output power when the device is modulated with an rms drive current at frequencies of
   (a) 20 MHz; (b) 100 MHz (c) 200MHz
2. Further, determine the 3 dB optical and electrical bandwidth for the device.
3. Also evaluate all the above parameters at 2 ns

Average carrier recombination life time (τ_i)	**Output power (uW)**			**Optical BW (MHz)**	**Electrical BW (MHz)**
	at 20MHz	**at 100 MHz**	**at 200 MHz**		
5ns					
2ns					

Conclusion: